LAKE MACQUARIE CITY

VOLUME 2: APPENDICES

LOCAL ADAPTATION PLAN FOR FUTURE FLOODING AND COASTAL RISKS

PELICAN, BLACKSMITHS, SWANSEA, SWANSEA HEADS AND CAVES BEACH

October 2021

This project has received financial support from the NSW Government through the Floodplain Grants Program

NSW GOVERNMENT

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Acknowledgment of Country

We remember and respect the Ancestors who cared for and nurtured this Country.
Dhumaan ngayin ngarrakalu kirraanan barayidin.

It is in their footsteps that we travel these lands and waters.
Ngarrakalumba yuludaka bibayilin barayida baaduka.

Lake Macquarie City Council acknowledges the Awabakal people and Elders past, present and future.
Lake Macquarie City Council dhumaan Awabakala ngarrakal yalawaa, yalawan, yalawanan.

Wording by the Aboriginal Reference Group and translated by Miromaa Aboriginal Language and Technology Centre.

PREFACE

Volume 2 of the Draft Local Adaptation Plan (LAP) for future flooding and coastal risks: Pelican, Blacksmiths, Swansea, Swansea Heads and Caves Beach is a supplement to the main LAP report (Volume 1).

As such, Volume 2 includes seven appendices to support Volume 1 - to provide additional information/detail that some readers will find useful to gain a full appreciation of the work undertaken by members of the LAP communities to prepare this plan.

We recommend Volume 1 of the LAP be read first and that Volume 2 be read in conjunction with relevant sections of Volume 1.

APPENDIX 1

Detailed descriptions for each of the 30 LAP actions

Appendix 1: Detailed descriptions for each of the 30 LAP actions

This appendix is the companion document to the LAP Action Summary tables provided in Volume 1 of the LAP **(Tables 3.1 to 3.6 in Section 3)**.

The following templates provide more detailed information on each of the 30 LAP actions to assist Council, the community and other stakeholders to further scope, implement, monitor, report and review LAP actions over the life of the LAP.

The 30 LAP action templates are grouped into 6 categories as follows:

- On-ground Works Actions

- Policy, Planning and Development Actions

- Maintenance Monitoring and Reporting

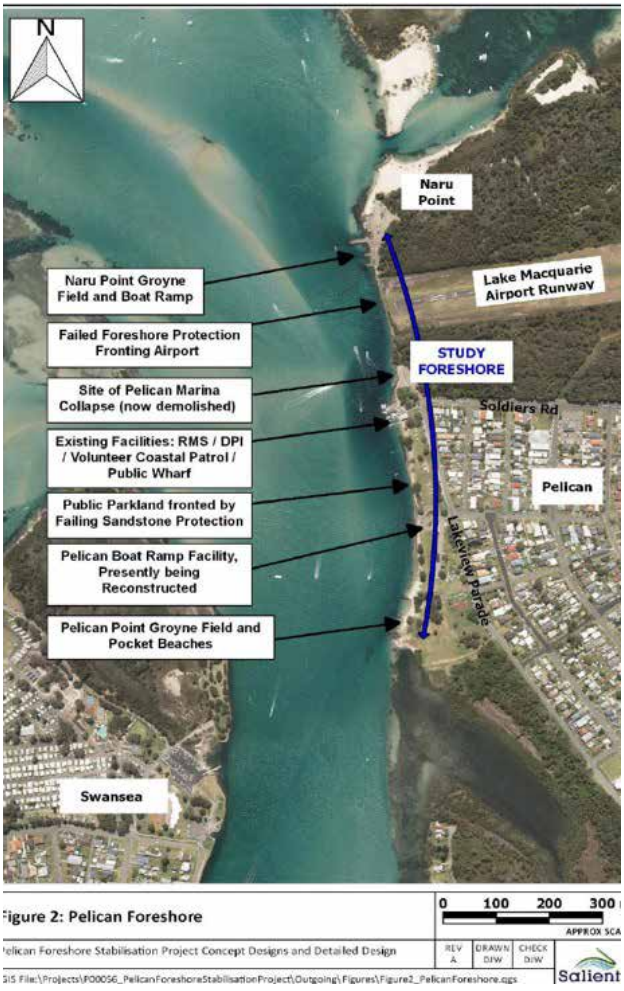
- Piloting Research and Innovation

- Advocacy and Engagement

- Governance and Funding

On-ground Works Action Description Template – OG1

Implement Pelican Foreshore Remediation Project (Naru Point to Pelican Groynes) - pending approval and funding

Detailed description/scope, including implementation actions (and folder number if available)	1. Complete hazard analysis, feasibility and CBA 2. Establish funding model with stakeholders 3. Secure funding for agreed stage/s 4. Complete detailed design 5. Secure planning approvals 6. Tendering and engagement 7. Construction 8. Monitoring and review Refer TRIM folder: PM17/0181 and Shape Lake Mac webpage (see Local Adaptation Plan page for updates) Refer Sycle Project: TBC
Location/Focus	 Figure 2: Pelican Foreshore Pelican Foreshore Stabilisation Project Concept Designs and Detailed Design
Priority/Timing	Immediate: 1-4 years
Trigger considerations	Foreshore erosion rate, water level (current foreshore/damage). Refer to Salients PHA and feasibility analysis
Hazards addressed	Channel dynamics, wave overtopping, inundation, sea level rise
Enterprise Risk Framework considerations:	Refer Sycle
Stakeholders	Landowners: Crown, Council (ES, AM/CRP), Airport, RMS, Bahtabah LALC, residents, business
Project control group and/ or contacts	Council, landowners, DPIE – TBC

Est. cost	$10-$20M, based on Salients/CIE CBA report
Funding Source	TBC: determined by funding model in CBA
LAP Multi-criteria Assessment (MCA) result?	No – not included in LAP – agreed being dealt with by separate Multi-criteria Analysis and Cost Benefit Analysis – refer PM/0181
Tested by CBA Y/N – comments	Yes: separate CBA to other LAP options. Undertaken as specific CBA on Pelican Foreshore Stabilisation
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report
Communications and engagement aspects	Yes: refer to C&E Plan in PM/0181
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Ongoing monitoring, evaluation and review, reporting and improvement are key aspects of this action. There is a high level of community interest and support for this action and community members have participated in monitoring by means of photographic record/s. Other monitoring, evaluation and improvement activities informed by actions MMR2-MMR4.
Summary: This action was first proposed in the Pelican and Blacksmiths working group and was considered one of the most pressing issues at the time. As such, early action has been undertaken including an options analysis, hazard analysis and cost-benefit analysis to understand what can be achieved to remediate the Pelican foreshore and mitigate erosion issues. It is envisioned that within this 10-year LAP this action will have been approved, funding sourced and begun or completed construction. Please refer to LAP page on Shape Lake Mac for further information and updates.	
Reference Documents:	Refer PM/0181: Salient erosion hazard analysis, options analysis and CBA: https://shape.lakemac.com.au/adapting-swansea/newsfeed/cost-benefit-analysis-executive-summary

 # please refer to final page of this Appendix for a glossary and list of abbreviations used in action templates.

On-ground Works Action Description Template – OG2 **Complete Swansea CBD tidal gates pilot and, subject to review, extend to priority drains in Swansea CBD and other impacted areas**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Source funding for pilot project 2. Identify suitable locations for installation of tidal gates 3. Source a range of tidal gate suppliers 4. Tendering and engagement 5. Construction 6. Monitoring and review 7. Assess suitability of upscaling pilot project, seek funding to expand to priority areas Refer TRIM folder: PM19/0102 and Shape Lake Mac page Refer Sycle Project: TBC
Location/Focus	
Priority/Timing	Immediate: 1 - 2
Trigger considerations	Existing – observable high tides/dry weather flooding at key sites in and around Swansea
Hazards addressed	Tidal inundation and sea level rise
Enterprise Risk Framework considerations:	Refer Sycle Risk Assessment; ensure operational during king tides; ensure gates open to allow exit of stormwater during local rainfall events
Stakeholders	Residents, shoppers, businesses, LGNSW, Fisheries, LAP WG,
Project control group and/or contacts	Council (ES, AM), LAP WG
Est. cost	$50K - $100K Pilot; $200K - $500K dependent on outcomes of Pilot
Funding Source	Grant Funding from Local Government NSW and DPIE as part of the Increasing Resilience to Climate Change programme, Council

LAP Multi-criteria Assessment (MCA) result?	Yes – 'low regrets' option – agreed being dealt with as immediate action; on-ground works
Tested by CBA Y/N – comments	No – business case being determined as part of pilot review
Planning considerations and other strategic linkages	Yes – REF prepared and approvals obtained for installation
Communications and engagement aspects	Yes: Reporting to community working group and wider community. Refer to videos on Swansea LAP Shape Lake Mac
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual performance reporting; also part of grant requirement
Summary: This action was proposed by the LAP Working Group and viewed as a 'low regrets' action to be implemented immediately to mitigate current tidal inundation issues in Swansea CBD. The project received funding support in 2019 from LG NSW and Council – it has been undertaken concurrently with the development of this LAP and will be completed within 1 year. It is envisioned that the tidal gates pilot project could be scaled-up and expanded to other areas in the LAP area and the wider local government area	
Reference Documents:	- Awareness video link - Increasing Resilience to Climate Change Grant Document PM19/0102 - Insert link to Shape Lake Mac page

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On-ground Works Action Description Template – OG3

Maintain and augment as necessary Channel and lake foreshore protection works

Detailed description/scope, including implementation actions (and folder number if available)	1. Enhance collaboration with landowners and agencies responsible for management of channel and lake foreshore 2. Monitor and manage training walls and lake foreshore in accordance with CZMP and upcoming CMP 3. Identify areas of channel erosion and suitability of protection works 4. Install, adjust or maintain existing training walls and foreshore protection works based on changes in channel dynamics 5. Investigate potential alternatives for raising of existing foreshore protection measures and/or adjustments of channel training walls Refer TRIM folder: F2010/02394/02 and F2010/02394/07. Doc No. TBC and Sycle Project: TBC
Location/Focus	Channel and lake foreshore, upstream of breakwaters. Private and public land.    
Priority/Timing	Immediate and ongoing
Trigger considerations	Foreshore erosion rate, water level (current foreshore/damage). Refer to Salients PHA and feasibility analysis.
Hazards addressed	Flooding, inundation, channel dynamics, East Coast Lows
Enterprise Risk Framework considerations:	Refer Sycle Risk Assessment; Community safety, environment; economic.
Stakeholders	Community, Crown Lands, Native Title, Residents, Tourism, Fisheries and DPIE
Project control group and/or contacts	Council (ES, AM), public and private landowners, DPIE - TBC
Est. cost	Est. $0.1 - 0.4M P.A.
Funding Source	In-part Council operation budget, other landowners/responsible agencies TBA
LAP Multi-criteria Assessment (MCA) result?	Flagged and assessed in MCA as low regrets option with recommendation to proceed to LAP. Refer also to related option around Black Neds Bay foreshore
Tested by CBA Y/N – comments	No – flagged as low regrets option in MCA

Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Links to CZMP 2015 and current CMP in preparation
Communications and engagement aspects	Yes: ongoing consultation, engagement and updates. Refer to links to actions in Engagement/Advocacy and also current CMP and consider C&E Plan in F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes: essential; annual reporting; also consider in context of MME 3
Summary: This action was proposed by the working group and viewed as both maintenance of existing foreshore protection and training walls, and the investigation into adjustments or raising of training walls and protection works. The raising of protection works at Blacksmiths, along Ungala Road, was analysed in the economic feasibility study which identified that the cost of doing these works outweighed the benefit of reduced damages (in 2020). There is room to extend research to understand alternative measures to provide protection works along the foreshore of the channel or adjustments to the existing training walls. Studies might include such things as alternate construction methods, the potential for community led responses/management, and/or coinciding these projects with raising of roads and property. It is envisioned that this action will include the management of channel protection works during the course of the LAP, and there will be proactive investigation into alternatives to existing channel foreshore protection measures	
Reference Documents:	CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary, LM CZMP and CMP documentation, inter-agency meetings Council, Crown and NSW MIDO

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On-ground Works Action Description Template – OG4

Raise residential floor levels and fill surrounding property to maintain ground levels above lake, channel and groundwater

Detailed description/scope, including implementation actions (and folder number if available)	1. Augment list of high-risk areas or neighbourhoods potentially impacted first 2. Investigate options for raising properties e.g. raise and fill or stilt construction methods etc 3. Undertake further research and consultation with relevant stakeholders into long-term strategy for raising properties in high risk areas. This includes an analysis of raising properties, roads and assets concurrently and in a co-design process with local residents 4. Prepare preliminary concept design and feasibility assessment 5. Undertake research into the effect of ad-hoc property raising in-line with current Council floor level requirements 6. Undertake further assessment into acceptable community trigger levels for property raising Refer TRIM folder: F2010/02394/02 and Sycle Project: TBC
Location/Focus	Location areas to be determined. Priority areas < 1.1m AHD. Consider in context of integrated raise and fill of roads and utilities
Priority/Timing	Medium: 4-10 years to begin preliminary investigations and pilots of high risk areas
Trigger considerations	Currently, assessed as the 10% AEP in the economic assessment Update trigger level based on new information and further investigation into community tolerances
Hazards addressed	Lake flooding, tidal inundation, sea level rise, groundwater
Enterprise Risk Framework considerations:	Yes: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Landowner including residents, Council, businesses, utilities
Project control group and/or contacts	Council (ES, IP, AM, DAC, Property), LAP working group
Est. cost	CBA estimated cost of raise/fill based on 'hotspot/case study example' at Pelican at $0.4M. The eventual cost estimates to be refined as a result of pilots/research being conducted under other action/s
Funding Source	Refer distribution analysis/funding aspects in CBA; landowner, Council, research and other grants, utility providers (where applicable)
LAP Multi-criteria Assessment (MCA) result?	Yes – assessed as high complexity/cost project that required further investigation in cost benefit analysis
Tested by CBA Y/N – comments	Yes – One 'hotspot' area at Pelican was investigated that included the raising of three properties by 2070. The results showed that the raising of properties in this area did not have a positive economic benefit. Results are highly sensitive to changes in water levels (construction costs and discount rates) as such, regular monitoring and review of new information is required. Results indicate that damages begin to increase significantly after 2050/70 which provides a loose timeframe for when a detailed long-term strategy is required for any high-risk areas. Also need to consider other areas < 1.1m AHD
Planning considerations and other strategic linkages	Yes – State Planning Legislature, LEP and DCP, consideration of scheduled road or utility upgrades/raisings, and consideration of the effect of raising and filling on neighbouring areas
Communications and engagement aspects	Yes – ongoing collaboration with LAP Working Group and consultation with residents and other stakeholders and updates in accordance with option GF-1. Essential to work closely with residents whose properties are in high risk areas. Refer to C&E Plan in F2010/02394/02

Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report
Summary: The community made a clear statement that they do not wish to relocate or move their properties. This action has the dual focus of 1. Adapting "in-place" to keep or improve the current lifestyle of these areas and; 2. To avoid maladaptation i.e. only raise properties when and where necessary. Council's role in this action is to facilitate adaptation opportunities for properties in high risk areas. Many properties will be raised above trigger levels when re-developed to meet current minimum floor requirements. For properties which are triggered to be raised by rising water levels, or to ensure that roads and assets are raised concurrently; it is important that high risk areas have a detailed long-term strategy to address future risks. In the current 10-year LAP, it is envisioned that this action will be tied with actions GF-5, GF6, PRI-6, PRI-7, AE-2, and AE-3 to ensure that there is a coordinated approach to raising of high-risk properties and associated infrastructure. It is hoped that a co-design approach with affected residents can be undertaken to ensure suitability and longevity of the action	
Reference Documents:	- Refer C&E Plan in F2010/02394/02 - Community Hazard Assessment Sheets and Salients PHA and Damages assessment https://shape.lakemac.com.au/adapting-swansea/widgets/210625/documents - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary

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On-ground Works Action Description Template – OG5 **Raise and improve the design and functionality of roads and drainage in impacted areas as lake, channel and sea levels rise**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Identify high risk areas 2. Investigate options for raising roads 3. Undertake further research and consultation with relevant stakeholders into long-term strategy for raising roads in high risk areas. This includes an analysis of raising properties, roads and assets concurrently and in a co-design process with local residents 4. Undertake further assessment into acceptable community trigger levels for roads and drainage 5. Further investigations to include a component on functionality of roads and drainage in these areas Refer TRIM folder: F2010/02394/02 and F2010/02394/07. Doc No. TBC and Sycle Project: TBC
Location/Focus	CBA included consideration of hotspot area/s around Pelican. Location of further areas to be determined. Priority areas < 0.8m AHD with consideration to safety, access and amenity. Consider in context of integrated raise and fill properties and utilities and sewerage which has been identified as a key focus of concern by local residents
Priority/Timing	Medium: 4-10 years to begin preliminary investigation into design and feasibility high risk area. The raising of roads needs detailed design and well-defined scheduling. Further consultation for details of raising roads needs to be undertaken with consideration of high-risk areas and concurrent property, roads, and asset raising
Trigger considerations	Currently, assessed in the CBA as raising roads periodically with the highest risk roads being raised first The trigger for raising roads will need further discussion with the community and residents of properties in high risk areas
Hazards addressed	Channel dynamics, wave overtopping, inundation, sea level rise
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, Residents, businesses, Utilities providers, Transport for NSW, Crown, Fisheries
Project control group and/or contacts	Council (AM-AI, ES), LAP Working Group, DPIE - TBC
Est. cost	CBA estimated cost of raising roads and drainage as > $35M. However final costs to be refined as a result of pilots/research being conducted under other action/s
Funding Source	Refer distribution analysis/funding aspects in CBA; landowner/resident/business, Council, research and other grants, utility providers (where applicable)
LAP Multi-criteria Assessment (MCA) result?	Yes – assessed as high complexity/cost project that required further investigation in cost benefit analysis
Tested by CBA Y/N – comments	Yes – CBA tested assumption of 43% of the roads across the LAP area were raised progressively to the 10% AEP event by 2050 (1.4m AHD). The results showed that there was not a positive economic benefit of raising 43% of roads in the LAP area by 2050. The results indicate that a mass road raising in the LAP area would not be economically feasible, however, there might be benefits by targeting road raising in specific high-risk areas. The CBA suggested that further investigation is undertaken in targeted areas which includes an assessment of concurrent raising of road, property and assets – in an integrated, sequenced approach
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report; State Planning Legislature, LEP and DCP, consideration of property or utility upgrades/raisings, and consideration of the effect of raising and filling on neighbouring areas
Communications and engagement aspects	Yes: ongoing consultation and updates in accordance with option GF-1, and close consultation with local landowners (residents, businesses, Crown) whose properties are in high risk areas Refer to C&E Plan in F2010/02394/02

Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report
Summary: The community made a clear statement that they do not wish to relocate or move their properties. As such, access to properties needs to be maintained and raising roads is likely to be required in high risk areas. Council's role in this action is to identify high risk areas that require road raising in the future and to facilitate the development and implement a detailed long-term strategy for these high-risk areas. In the current 10-year LAP, it is envisioned that this action will be tied with actions GF-4, GF6, PRI-6, PRI-7, AE-2, and AE-3 to ensure that there is a coordinated approach to raising of high-risk properties and associated infrastructure. It is hoped that a co-design approach with affected residents can be undertaken to ensure suitability and longevity of the action	
Reference Documents:	- Refer F2010/02394/02 - Community Hazard Assessment Sheets and Salients PHA and Damages assessment https://shape.lakemac.com.au/adapting-swansea/widgets/210625/documents - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary

On-ground Works Action Description Template – OG6 **Raise and fill CBD to ensure access and functionality and ensure social and economic sustainability**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Investigate options for raising CBD 2. Undertake further research and consultation with relevant stakeholders into long-term strategy for raising CBD. This includes an analysis of raising properties, roads and assets concurrently and in a co-design process with local residents 3. Undertake research into the effect of ad-hoc property raising (and/or other CBD raising methods) in-line with current Council floor level requirements 4. Undertake further assessment into acceptable community trigger levels for raising of CBD area 5. Undertake further analysis into the economic benefits of revitalising the Swansea CBD Refer TRIM folder F2010/02394/02 and F2010/02394/07. Doc No. TBC and Shape Lake Mac page. Refer Sycle Project: TBC
Location/Focus	Refer CBA, options description/s The community identified a revitalised Swansea business centre - and long-term viability of commercial and social assets as a key priority. 
Priority/Timing	Med-Long term: 4-10 years to begin preliminary investigation into potential concepts and further feasibility
Trigger considerations	- Currently, assessed in the CBA as when the 1% AEP is above the floor level of a property. Essential to also consider higher frequency 'dry weather' flooding ie: tidal inundation impacts - The trigger for raising floors, roads, utilities (integrated sequencing) will need further discussion with the community and business owners
Hazards addressed	Catchment flooding, tidal inundation, storm surge, East Coast Lows, SLR
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Landowners: Council, Residents, businesses, Utilities providers, Transport for NSW, Crown, Fisheries
Project control group and/or contacts	Council (ES, IP, Property, AM), Business chamber, Dantia

Est. cost	CBA report estimated raising of CBD at around $0.4M based on option (scope/ assumptions) tested where only 10 properties were triggered for raising. Final cost estimates will be refined/update estimates as a result of research and pilots outlined in other LAP action/s
Funding Source	Funding of this action requires further investigation as outlined in management action GF3 and other actions related to piloting, research and innovation. The NSW Coastal Management Framework provides further direction around funding models for coastal management works/activities
LAP Multi-criteria Assessment (MCA) result?	No – not included in LAP – agreed being dealt with by separate Multi-criteria Analysis and Cost Benefit Analysis – refer PM/0181
Tested by CBA Y/N – comments	Yes – The CBA indicated that 10 properties would be triggered for raising by 2070. The results showed that there was not an economic net benefit to raising these properties. However, these results do not include potential increases in economic benefits due to the revitalising of the Swansea CBD and there is sufficient reason to investigate potential options which might meet both economic and social benefits of raising the CBD. Importantly, the CBA indicates that damages to properties in the CBD increase significantly after 2050; approximately doubling every year. This could be used as an indicative timeframe for when major adaptation actions need to begin implementation
Planning considerations and other strategic linkages	Yes: Coastal Management Framework Refer CBA and Hazard Report – (Adapting Swansea Shape Lake Mac site) State Planning Legislation, LEP and DCP, consideration of property or utility upgrades/raisings, and consideration of the effect of raising and filling on neighbouring areas
Communications and engagement aspects	Yes – ongoing consultation and updates with business and residents in accordance with option GF-1, particularly close consultation with local businesses whose properties are in high risk areas. Liaison with TfNSW.
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report
Summary: The community wish to maintain the function of the Swansea CBD as it was noted as the main economic drive in the area. Furthermore, there was several indications that the CBD could be improved to allow an increased economy and attract investment in the area. As such, access to the CBD needs to be maintained and protection from rising sea levels is likely required. The community did not wish to relocate the Swansea CBD and considered the most appropriate option would be for a structured raising of the CBD. Council's role in this action is to investigate opportunities for raising and possibly revitalising the Swansea CBD. Council will need to consult business, and the community to facilitate the development of and implement a detailed long-term strategy for the CBD. In the current 10-year LAP, it is envisioned that this action will be tied with actions GF-4, GF5, PRI-6, PRI-7, AE-2, and AE-3 to ensure that there is a coordinated approach to raising of high-risk properties, the CBD, and associated infrastructure	
Reference Documents:	- Refer F2010/02394/02 - Community Hazard Assessment Sheets and Salients PHA and Damages assessment https://shape.lakemac.com.au/adapting-swansea/widgets/210625/documents - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary

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On-ground Works Action Description Template – OG7 **Actively manage beach and dune integrity. Implement stabilisation works in accordance with LM CZMP (2015), CMP (currently being prepared) and monitoring**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Continue CoastWatch and other coastal hazard monitoring and reporting program to evaluate and report on dune erosion/accretion process 2. Regular meetings and formalised annual review by LM Coastal Management Committee to ensure Council and community have been actively managing and stabilising dune systems, and opportunities for collaboration on future works. 3. Continue to monitor and actively respond to effects of large storm events and risk to assets in a proactive and timely way based on emergency sub-plans and established triggers 4. Source opportunities to expand existing management options such as further research on: erosion and/or wave overtopping modelling, risk assessments, trigger levels, and new technologies for dune management or stabilisation Refer TRIM folder: F2010/02394/02 and Shape Lake Mac page Refer Sycle Project: TBC
Location/Focus	Lake Macquarie Coastline, potential high risk areas identified in CZMP and current CMP (including coastal emergency sub-plan)
Priority/Timing	Ongoing management - In 4 years design/source opportunities to expand management options and implement novel (new or emerging) options within 10-years or if required beforehand based on coastal protection advice and measures including new and emerging technologies as they become available (e.g. the recent use of rock-fillet bag technology in the channel and/or elsewhere on the coast)
Trigger considerations	Action is ongoing. Trigger levels for emergency response considered in CMP Emergency Management Subplan. Direction is required to understand potential trigger levels for expanded beach and dune management/stabilisation
Hazards addressed	Coastal Hazards, and East Coast Lows
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Coastal residents, tourists, Council, Crown, Surf Lifesaving, Community groups
Project control group and/or contacts	Council (ES, CP, AM, Leisure), LAP working group and other community group representatives, Crown/MIDO
Est. cost	$0.2M - $0.5M PA TBC
Funding Source	Council annual budget, Council grants, research grants, and support of NGOs
LAP Multi-criteria Assessment (MCA) result?	Discussed briefly in MCA, considered part of BaU/Low Regrets options and CMP
Tested by CBA Y/N – comments	No – refer to CZMP 2015 and current CMP activities
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. State Planning Legislation, LEP and DCP, CZMP (2015), and upcoming CMP
Communications and engagement aspects	Yes – ongoing consultation and updates in accordance with option GF-1. Liaison with Coastal Committee to ensure targeted community engagement: refer to C&E Plan in F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report.
Summary: This action received strong community support at workshop held at Swansea Belmont SLSC in April 2019. Subsequent changes in beach and dune morphology have reinforced the need for more active management of coastal beach and dune systems. The action has a dual purpose of expanding existing management, stabilisation and monitoring of beaches and dunes and investigating additional avenues to ensure public safety, amenity and environmental integrity. Strong links to current studies being conducted as part of CMP	
Reference Documents:	INSERT: - Reference Pelican Blacksmiths Precinct Concepts - LM CZMP 2015 - Link to current LM CMP Shape Lake Mac page https://shape.lakemac.com.au/coastal

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Planning and development control Action Description Template – PDC1 **Ensure new approved buildings are constructed with floor levels above projected flood levels and/or in accordance with relevant Council policy and planning framework**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Ensure all DA's reviewed in accordance with the LM Flooding and Tidal Inundation Policy, LEP and DCP under guidance of the LM SLR DA assessment task group 2. Monitor the rate of new construction for homes with current floor levels below current 1% AEP and report in SoE report or LM ESSAP report 3. Continue to monitor, review, and manage the risks associated with climate change and review flood planning benchmarks if and when the NSW Government recommends a new level under its planning and/or in the light of new scientific evidence (refer MMR3) Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	All LAP areas: desktop/planning analysis
Priority/Timing	Immediate: 1-3 years and ongoing
Trigger considerations	Foreshore erosion rate, water level (current foreshore/damage). Refer to Salients PHA and feasibility analysis and ongoing review of lake and ocean water levels
Hazards addressed	Catchment/lake flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework (ERF) considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Landowners: Local residents, businesses, building and development industry, Council
Project control group and/or contacts	Council (IP, DAC, ES, Property), LAP Working Group and/or development representatives
Est. cost	<$50K
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	No
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report (available on Adapting Swansea Shape Lake Mac site), LEP, DCP and potential Precinct Area Plan under DCP
Communications and engagement aspects	Essential: Residents, building and development sector. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered and described briefly in the MCA	
Reference Documents:	- Coastal Management Framework - LM Waterway Flooding and Tidal Inundation Policy - LM LEP and DCP

 # please refer to final page of this Appendix for a glossary and list of abbreviations used in action templates.

Planning and development control Action Description Template – PDC2 **Review and update Council planning and building regulations to adapt to current and future flooding and sea level rise risk**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Review LM Development Control Plan (DCP) and associated guidelines to ensure appropriate flood planning levels and conditions for LAP areas 2. Investigate feasibility of Precinct Area Plan for vulnerable areas in LAP suburbs 3. Pending feasibility, draft and exhibit Precinct Area Plan in collaboration with community and industry stakeholders 4. Seek formal approval and implement Precinct Area Plan in collaboration with Council, community and industry stakeholders Refer: F2010/02394/02 and F2010/02394/07
Location/Focus	All LAP areas: desktop/planning analysis along with community and industry engagement
Priority/Timing	Immediate: 1-4 years and ongoing
Trigger considerations	Immediate and as triggered by MMR-1 and changes in NSW DPIE policy or in light of new scientific evidence or Council Policy
Hazards addressed	Catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework (ERF) considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment – particularly community and industry engagement and customer service
Stakeholders	Council, residents, businesses, building and development industry, Department of Planning
Project control group and/or contacts	Council (IP, DAC, ES, Property), LAP Working Group and/or industry representatives
Est. cost	<$50K
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	No
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report, LEP, DCP and potential Precinct Area Plan under DCP
Communications and engagement aspects	Essential: Residents, Building and development sector. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR1 and MMR3; incl. in LM ESSAP and LM SOE report. Include MERI aspects as part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered and described briefly in the MCA and recommended to proceed directly to the LAP. Council and community experience with the Marks Point and Belmont South LAP in 2015/16 suggested reviewing development planning instruments applying in the LAP area is necessary to support future adaptation/resilience and to provide residents and the building/development sector with confidence in responsible future development potential of the area	
Reference Documents:	- Coastal Management Framework - LM Waterway Flooding and Tidal Inundation Policy - LM LEP and DCP

 # please refer to final page of this Appendix for a glossary and list of abbreviations used in action templates.

Planning and development control Action Description Template – PDC3 **Identify and seek approval for use of suitable land for future inundation and/or adaptation pilots**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Pending outcomes MMR-1, MMR-3, MMR4, PRI-1 and PRI-3. 2. Consider and address provisions of State and Local planning provisions in land use planning medium-long term Refer F2010/02394/02 and F2010/02394/07
Location/Focus	TBC – subject to further investigation
Priority/Timing	Medium/5 to 10 years, ongoing
Trigger considerations	Foreshore erosion rate, water level (current foreshore/damage). Refer to Salients PHA and feasibility analysis. Permanent and/or temporary inundation
Hazards addressed	Catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework (ERF) considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Landowners including Council, local residents, businesses, building and development industry, Crown, others, Universities, Utilities
Project control group and/or contacts	Council (IP, DAC, ES, Property), LAP Working Group
Est. cost	TBC – pending outcomes of business case on specific proposals
Funding Source	Council and/or other relevant landowner, potential for grant funding
LAP Multi-criteria Assessment (MCA) result?	Briefly discussed in MCA and identified as potential adaptation option Not recommended to proceed to CBA for detailed analysis
Tested by CBA Y/N – comments	Limited discussion in the CBA in the context of the need for further research and piloting of a variety of adaptation options. Further feasibility analysis essential before proceeding
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report, LM LEP, LM DCP and potential Precinct Area Plan under LM DCP as outlined in PDC2 above
Communications and engagement aspects	Essential: Residents, building and development sector, Government and non-government organisations. Refer to Comms and Engagement Plan
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in LM ESSAP and LM SOE report Include MERI aspects as part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered and described briefly in the MCA. Council and community experience with the Marks Point and Belmont South LAP in 2015/16 suggests the need for further research and piloting of a variety of adaptation options. Further feasibility analysis essential before proceeding	
Reference Documents:	- Coastal Management Framework - LM Waterway Flooding and Tidal Inundation Policy - LM LEP and DCP

 # please refer to final page of this Appendix for a glossary and list of abbreviations used in action templates.

Planning and development control Action Description Template – PDC4 **Council's land use planning and development controls in collaboration with industry and community as new scientific information comes to hand**	
Detailed description/scope, including implementation actions (and folder number if available)	Related to actions PDC1 and MMR1 and as directed by the LM Flooding and Tidal Inundation Policy: 1. Continue to monitor, review, and manage the risks associated with climate change and review flood planning benchmarks if and when the NSW Government recommends a new level under its planning and/or in the light of new scientific evidence 2. Review and maintain Council's strategic and development planning instruments (including LM LEP and LM DCP) to ensure appropriate flood planning levels for LAP areas F2010/02394/02 and F2010/02394/07
Location/Focus	All LAP areas: desktop/planning analysis
Priority/Timing	Immediate: 1-4 years and ongoing
Trigger considerations	Foreshore erosion rate, water level (current foreshore/damage). Refer to Salients PHA and feasibility analysis. Permanent and/or temporary inundation
Hazards addressed	Catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework (ERF) considerations:	Essential: consider all aspects of LM ERF in Sycle project risk assessment
Stakeholders	Landowners: Local residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, IP, DAC, Property), LAP Working Group
Est. cost	<$50K
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA for detailed analysis though considered as part of enhanced base case
Tested by CBA Y/N – comments	Limited discussion in the CBA in the context of the need for ongoing monitoring of water levels and new scientific advise received
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – LEP, DCP and potential Precinct Area Plan under DCP. Reference also to the LM Flooding and Tidal Inundation Policy
Communications and engagement aspects	Essential: Residents, building and development sector. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents – and the LM Flooding and Tidal Inundation Policy
Summary: This action was considered and described briefly in the MCA and CBA. The LM Flooding and Tidal Inundation Policy reinforces the need for Council to maintain a watching brief on new scientific information (international, national and state) regarding sea level rise. The IPCC AR6 is scheduled for release in 2021/22, with the findings being considered in any future review of Council's planning documentation. Residents and industry have a reasonable expectation that clear direction and guidance will be provided to inform development decisions	
Reference Documents:	- Coastal Management Framework -LM Waterway Flooding and Tidal Inundation Policy, -LM LEP and DCP and the LM Flooding and Tidal Inundation Policy

Planning and development control Action Description Template – PDC5 **Implement (current) LM Coastal Zone Management Plan (CZMP 2015) actions relevant to LAP and subsequent Coastal Management Program (CMP in preparation) actions relevant to LAP - ensure consistency and updates as required**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Continue to implement existing LM CZMP actions related to coastal hazards and local adaptation planning until the LM CMP (currently in preparation) is approved 2. Ensure provisions of the new LM CMP (once approved) are adequately reflected in LAP actions 3. Continue to implement, monitor, report on and review as necessary the CMP actions being addressed as part of the LAP. Update both documents (CMP and LAP) in accordance with review provisions) Refer F2010/02394/02 and F2010/02394/07
Location/Focus	All LAP areas: desktop/planning analysis
Priority/Timing	ongoing implementation of CZMP (2015). Updated CMP within 4-years and ongoing implementation of CMP
Trigger considerations	Completion and approval of LM CMP and/or changes to CMP actions relating to the LAP
Hazards addressed	All coastal hazards as reflected in the LM CMP and the LAP
Enterprise Risk Framework (ERF) considerations:	Essential: consider all aspects of Council's ERF in Sycle project risk assessment
Stakeholders	Council, NSW Government and non-government organisations, residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, various), LM Coastal Zone Management Committee
Est. cost	TBC as reflected in LM CZMP and CMP
Funding Source	Council, NSW Government, Grants
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Consistent with provisions of Marks Point and Belmont South LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	No
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Current LM CZMP and future LM CMP
Communications and engagement aspects	Essential: All LAP, LM CZMP and CMP stakeholders. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in LM ESSAP and LM SOE report As part of regular review and update of LM CZMP and CMP
Summary: This action was considered and described briefly in the MCA. Council and community experience with the Marks Point and Belmont South LAP in 2015/16 suggested that strong linkages/ integration between LAPs and the CZMP is essential.	
Reference Documents:	- Coastal Management Framework, including current LM CZMP and future LM CMP (in preparation) Refer CMP Shape Lake Mac page https://shape.lakemac.com.au/coastal

Maintenance, monitoring and reporting action description template – MMR1 **Monitor and review new scientific evidence and data/information on flooding, sea level rise risk and other coastal hazards in order to review/revise Local Adaptation Plan as necessary**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Continue to monitor coastal areas in accordance with CZMP (2015), and the upcoming CMP 2. Council to ensure sufficient resourcing for the review, monitoring, and assessment of risk from flooding, sea level rise and other coastal hazards. 3. Council to review LAP following the release of international reports/strategies, e.g. IPCC reports, international frameworks etc., to ensure consistency, relevancy, and best practice 4. Council to invest in research and innovation to understand risks from flooding, sea level rise, and other coastal hazards, particularly considering the current and expected rapid increase in the rate of scientific understanding F2010/02394/02 and F2010/02394/07
Location/Focus	All LAP areas: desktop/planning analysis
Priority/Timing	Ongoing
Trigger considerations	MMR framework for all coastal hazards identified by Council and community working group. Reference also to CZMP and CMP MMR, including open coast, channel, lake and groundwater
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, government and non-government organisations, local residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, AM, DAC, Property), LAP Working Group
Est. cost	$0.1M - $0.2M
Funding Source	Council, NSW Government, University and/or Grants TBC
LAP Multi-criteria Assessment (MCA) result?	Flagged in MCA as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response.
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation)
Communications and engagement aspects	Essential: Residents, building and development sector, industry, tourism, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered and described briefly in the MCA and was identified as a key recommendation in the CBA undertaken as part of the LAP's preparation. Specific examples include: - Lake water level monitoring (currently being undertaken NSW Government) with an assessment report being prepared by Manly Hydraulics Laboratory - Open coast monitoring – beach and dune condition - regular monitoring of land formation using aerial LiDAR data	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Maintenance, monitoring and reporting action description template – MMR2 **Undertake a detailed survey of Swansea Channel morphology and asset condition every 5 years (2025/26 and 2030/31) to monitor channel dynamics and the impact of channel management practices including dredging**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Scoping of survey in partnership with key stakeholders including NSW DPIE, Crown Lands, TfNSW (MIDO) 2. Undertake survey, analyse and summarise results 3. Review related plans and strategies including channel dredging strategy and asset management plans Refer F2010/02394/02 and F2010/02394/07
Location/Focus	All LAP areas: desktop/planning analysis
Priority/Timing	Every 5 years detailed survey with continued monitoring between surveys
Trigger considerations	MMR framework for all coastal hazards identified by Council and community working group. Reference also to CZMP and CMP MMR, including open coast, channel, lake and groundwater
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, AM, DAC, Property)
Est. cost	TBC
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation)
Communications and engagement aspects	Essential: Residents, building and development sector, industry, tourism, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered and described briefly in the MCA and was identified as a key recommendation in the CBA preparation. Monitoring of the entrance channel is also an action in the current LM CZMP and has been flagged as a priority in the scoping study prepared for the LM CMP currently being prepared.	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Maintenance, monitoring and reporting action description template – MMR3: **Adjust programmed monitoring and maintenance of Council roads, stormwater infrastructure, channel revetments and other assets to ensure asset condition is maintained and consistent with agreed adaptation triggers**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Audit existing maintenance and monitoring plans for roads, drainage, channel revetments and other assets against LAP hazards 2. In collaboration with Council City Works and City Planning teams, adjust existing maintenance and monitoring plans to ensure high risk areas/assets are maintained/monitored at optimum schedules based on data and established trigger levels (PRI-7) 3. In collaboration with Council's City Works and City Planning teams, and the Community, assess condition of assets, and investigate potential triggers for action in-line with actions OG-3 to OG-6 Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Various – directed by asset location and hazard exposure
Priority/Timing	1-4 years
Trigger considerations	MMR framework for all coastal hazards identified by Council and community working group. Reference also to CZMP and CMP MMR, including open coast, channel, lake and groundwater
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, AM, Property, various)
Est. cost	TBC
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation)
Communications and engagement aspects	Essential: Residents, building and development sector, industry, tourism, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered in the MCA and was described briefly in the CBA undertaken as part of the LAP's preparation. Council's current monitoring and maintenance program is based on recommendations of previous flood and coastal management studies and plans. Requires regular review and updating in light of new scientific information. Feedback during LAP preparation and exhibition flagged that ongoing monitoring of drainage (condition/function) is required to inform timely maintenance.	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Maintenance, monitoring and reporting action description template – MMR4: **Targeted monitoring and reporting of hazards and regular comparison to existing triggers for action e.g. monitoring and reporting of water levels in ocean, lake and channel; inundation frequency, extent and duration**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Review existing monitoring programs and plans related to flooding and inundation e.g. water levels, groundwater levels, recession, erosion 2. Identify data gaps and install or commission relevant monitoring required to correct data gap 3. Council to regularly assess and report on flooding and other coastal hazard monitoring data particularly during large events with high risk from hazards Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Various – directed by asset location and hazard exposure
Priority/Timing	Ongoing monitoring of existing and future programs/plans; within 4 years identify and correct data gaps
Trigger considerations	MMR framework for all coastal hazards identified by Council and community working group. Reference also to CZMP and CMP MMR, including open coast, channel, lake and groundwater
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, businesses, building and development industry
Project control group and/or contacts	Council (ES, various TBC), NSW Government/DPIE
Est. cost	$0.1M-$0.2M
Funding Source	Council
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation)
Communications and engagement aspects	Essential: Residents, building and development sector, industry, tourism, government and non-government organisations. Refer to Comms and Engagement Plan 2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered in the MCA and was described briefly in the CBA undertaken as part of the LAP's preparation. Council's current monitoring and maintenance program is based on recommendations of previous flood and coastal management studies and plans. Requires regular review and updating in light of new scientific information	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI1: **Regularly review research outcomes, case studies and actions arising from adaptation programs in other locations to consider and incorporate where possible those feasible for application in our local setting.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Council to ensure sufficient resourcing for the review, monitoring, and assess adaptation, mitigation, and/or resilience programming; primarily in Australia but with scope to include international development within these areas 2. New innovative programs and technology should be assessed and potentially piloted as necessary 3. Council to invest in its own research and innovation to ensure continue progress in the area of adaptation, mitigation, and/or resilience Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Various – directed by asset location, characteristics and hazard exposure
Priority/Timing	Ongoing management/investment in resources for research and innovation
Trigger considerations	MMR framework for all coastal hazards identified by Council and community working group. Reference also to CZMP and CMP MMR, including open coast, channel, lake and groundwater. Informed by IPCC AR cycle, CSIRO, Commonwealth and State Government reporting along with scientific literature.
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, businesses, various
Project control group and/or contacts	Council (ES, various TBC), NSW Government/DPIE, others TBC
Est. cost	$0.1 - $0.2M pa
Funding Source	Council, others TBC
LAP Multi-criteria Assessment (MCA) result?	Flagged in LAP as low regret option to be included in LAP. Not required to proceed to CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation).
Communications and engagement aspects	Essential: Residents, building and development sector, industry, tourism, government and non-government organisations. In line with GF1. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action was considered in the MCA and was described briefly in the CBA undertaken as part of the LAP's preparation. Council and the volunteer Working Group are committed to learning from research and piloting of real-world solutions in other locations within NSW, Australia and the world. Where viable/feasible/acceptable, lessons learnt from other locations will be tested/piloted in Lake Macquarie	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI2: **Further investigate the feasibility of options to protect wetland assets in the LAP area by such means as: raising wetlands in-situ, allowing wetlands to move landward and offsetting wetlands elsewhere in response to projected sea level rise.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Engage with Universities and and other researchers to understand potential joint research and project opportunities 2. Council (possibly in coordination with Universities) to undertake a literature and case study review to understand existing projects in this area locally, nationally, and internationally 3. Council to assess options for potential pilot study to examine wetlands e.g. for raising wetlands or allowing wetlands to retreat 4. New innovative programs and technology should be assessed and potentially piloted as necessary e.g. investigate opportunities to support blue carbon initiatives Refer F2010/02394/02 and F2010/02394/07
Location/Focus	 Various – directed by wetland location, characteristics and hazard exposure. Suitable wetland areas within the City. This might include wetlands on Coon Island or Black Ned's Bay, however, a more suitable pilot study might be found in another area of the Local Government Area
Priority/Timing	Initial scoping type studies within the first 4 years of the plan. Potential for a pilot study within the 10-year action plan. Ongoing investment in resources for continuing research and innovation
Trigger considerations	No trigger level is currently understood for this action. Further research is required to understand how wetlands adapt to rising sea levels, and a trigger level for raising, retreating or relocating wetlands might be achieved from this research
Hazards addressed	All: catchment flooding, tidal inundation, channel dynamics, groundwater, storm surge, east coast lows, open coast hazards
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, government and non-government organisations, local residents, research organisations including universities
Project control group and/or contacts	Council (ES, various TBC), NSW Government/DPIE, others TBC
Est. cost	$0.1M - $0.5M
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Assessed as requiring further assessment and sent to the CBA for feasibility assessment
Tested by CBA Y/N – comments	Qualitatively analysed in CBA with a recommendation for pilot studies to assist with understanding economic feasibility
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation)
Communications and engagement aspects	Essential: Residents, industry, tourism, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: The objective of this action is to increase our understanding of wetlands reaction to sea level rise. Ultimately, this action will provide the background information used to support decisions on when, how, and where we can adapt our wetlands to the impacts of climate change and sea level rise	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI3: **Further investigate the usage and values of the diverse recreational land assets that are subject to flooding and sea level rise. Ensure that future management of recreational land in the area considers LAP hazards and adaptation options.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Council to undertake land use surveys and studies of recreational areas including community values and utilisation of recreational land use types 2. Council to investigate options for innovative solutions such as artificial turf recreational facilities (mitigating issues such as saltwater intrusion and impacts on grass vegetation) 3. Council to undertake research into the valuation of land, and assets (both natural and artificial) on recreational areas to better understand potential costs of loss or adaptation in these areas. 4. Council to manage recreational areas based on risk, usage, land use, values, cost, and capacity to adapt Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Various – directed by recreational land location, characteristics and hazard exposure of recreational lands within the LAP area.
Priority/Timing	Initial research and development of scoping type studies within the first year of the plan. Potential for a pilot study within 4 years of the action plan. Ongoing investment in resources for continuing research and innovation
Trigger considerations	No trigger level is currently understood for this action. However, continued research might assist in developing a trigger for future actions associated with recreational facilities
Hazards addressed	Tidal inundation, channel dynamics, catchment flooding, East Coast lows, and groundwater
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, community recreation groups, research organisations including universities
Project control group and/or contacts	Council (ES, AM, various TBC), NSW Government/TBC
Est. cost	$0.1 - $0.2M
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Not specifically addressed in MCA conducted as part of LAP, however, identified as an outcome/recommendation of the CBA
Tested by CBA Y/N – comments	Identified and recommended in CBA as an essential action in future adaptation response. Raising recreational facilities was assessed by an economic feasibility study and the results showed that there was not a positive cost-benefit. However, the analysis was based on limited data, and much of the data was sourced from out of area i.e. recreational facilities in Sydney for land use costing. As such, the recommendation from the economic feasibility study was to undertake site specific studies to determine feasibility and potentially a variety of options for adaptation of these facilities
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP
Communications and engagement aspects	Essential: Residents, industry, tourism, community recreation groups, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic (land use) planning documents
Summary: The MCA and CBA undertaken to support the LAP found significant gaps in information available on the values and usage patterns of Council's diverse portfolio of recreational assets (natural areas, open space, sports fields, playgrounds etc). The objective of this action is to increase our understanding of the use, value and ongoing management of recreational land both currently and in response to projected sea level rise and coastal hazards. Ultimately, this action will provide the background information used to support decisions on when, how, and where we can adapt our recreation areas in response to projected the impacts of climate change including sea level rise	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI4: **Council consider the outcomes of the options assessment (MCA and CBA) undertaken on Swansea Holiday Park in its current and future strategic planning for management of holiday park assets in the LAP area.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Council to review results of CBA for Swansea Holiday Park and its implications on strategic planning 2. Council to review and update strategic plan for Swansea holiday Park with consideration of economic benefit from tourism and reference to new information from LAP actions PRI-2 (wetland retreat) and PRI-6 (adaptive design and construction research) 3. Implement actions from updated strategic planning for Swansea Holiday Park Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Swansea Holiday Park and potential retreat/relocation areas
Priority/Timing	Immediate: Review of MCA/CBA implications and updating of strategic plan within first 4 years action plan
Trigger considerations	No trigger level is currently understood for this action. However, further assessment and strategic planning in the first 4 years will assist with determining remaining asset life, risks and preferred triggers for adaptation
Hazards addressed	Tidal inundation, channel dynamics, catchment flooding, East Coast lows, and groundwater
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, government and non-government organisations, local residents, community recreation groups, research organisations including universities
Project control group and/or contacts	Council, community, part-time/full-time residence of Swansea Holiday Park
Est. cost	$0.1-$0.5M
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	MCA consider this as a high risk/high cost option and required additional investigation in CBA
Tested by CBA Y/N – comments	Both “raise and fill” and “relocate” Swansea Holiday Park were assessed as potential options in the CBA and the results showed that there was not a positive cost-benefit at the current point in time. However, the analysis was based on limited data currently available and the future management of holiday parks will need to consider changes in asset condition and hazard exposure
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP
Communications and engagement aspects	Essential: Residents, industry, tourism, community recreation groups, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council’s strategic (land use) planning documents
Summary: The MCA and CBA undertaken to support the LAP included assessment of future options to manage Swansea Holiday Park. Whilst the results showed that there was not a positive cost-benefit at the current point in time the analysis was based on limited data currently available. Council’s Property Department responsible for operation and strategic planning for Council managed assets including Holiday Parks and the future management of holiday parks will need to consider changes in asset condition, hazard exposure and user safety and amenity. Ultimately, this action will support decisions on when, how, and where we can adapt our Holiday Park assets in response to projected impacts of climate change including sea level rise	
Reference Documents:	- Coastal Management Framework - CBA: https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI5:

Further investigate adaptation options for Black Ned's Bay foreshore at the vulnerable residential area between the Black Ned's Bay and the Pacific Highway

Detailed description/ scope, including implementation actions (and folder number if available)	1. Investigate options and costs for scaling up Swansea Tidal Gates Pilot in open channel at Black Ned's Bay 2. Engage with residents of this area (between Black Ned's Bay and Bowman Street/Pacific Highway) to actively investigate and assess current and future coastal hazard risk to their properties and their capacity to prepare and respond 3. Collaborate with the residents of this area (between Black Ned's Bay and Bowman Street/ Pacific Highway) to identify and further investigate flood preparedness and adaptation options including innovative methods for foreshore protection, mitigation methods, emergency preparedness actions, and options for raise and filling in a well organised manner 4. Develop an enhanced understanding of the business case for the full range of adaptation options available in the area including consideration of distribution analysis and funding options Refer F2010/02394/02 and F2010/02394/07
Location/Focus	Residential area between Black Ned's Bay and Bowman Street/Pacific Highway
Priority/Timing	Resident engagement and collaboration to help scope the action within 4 years of LAP Swansea tidal gate scale-up to be assessed within 4 years of LAP Potential implementation of targeted investigations/pilots for the area within the 10-year action plan. Ongoing monitoring, review and adaptation
Trigger considerations	Given the diversity of land and floor levels in this location, a definitive/universal trigger has not yet been identified for this action. However, it is expected this action will assist Council and the community to identify potential triggers for emergency preparedness/response, and/or for larger scale works such as foreshore protection works, raising floor levels, filling public/private land and raising sewerage and drainage
Hazards addressed	Tidal inundation, channel/foreshore dynamics, catchment flooding, East Coast lows, and groundwater
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, local residents in selected area, government and non-government organisations, community and business groups, research organisations including universities
Project control group and/or contacts	Council (ES, various TBC), local resident working group, NSW Government/TBC, utilities providers, university
Est. cost	$0.1-$0.5M
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA conducted as part of LAP – recommended for inclusion as an option to be assessed in the CBA
Tested by CBA Y/N – comments	Yes – economic feasibility analysis (the CBA) suggested that there was not a positive benefit cost for constructing an engineered sea-wall in the area of Black Ned's Bay based on available data and assumptions used in the model. However, the CBA recommended that further monitoring, research and pilots be undertaken to explore feasibility of options Council and the community working group anticipate a broader range of options may be identified, scoped and assessed in closer collaboration with potentially impacted residents
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report As part of regular review and update of Council's strategic (land use) planning documents
Summary: Council, the working group and technical consultants assessed the narrow strip of land between Black Ned's Bay and the Pacific Highway/Bowman street as at risk to tidal inundation, storm surge and catchment flooding. The frequency, duration, extent and associated impacts of dry weather inundation and storm event flooding will increase, particularly after 2050-2070. The CBA assessed the option of an engineered sea-wall as not economically viable at the present time. However, there are a range of short-, medium- and long-term options for this area that need further investigation and assessment. Close engagement and collaboration with residents and land owners within the Black Ned's Bay area is considered essential if we are to implement timely and effective preparedness and adaptation measures	
Reference Documents:	- Coastal Management Framework - CBA:https://shape.lakemac.com.au/adapting-swansea/news_feed/cost-benefit-analysis-executive-summary - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI6: **Promote research, development and piloting of flood resilient and adaptable design and construction methods to support residential and business development in the area. Particular focus on collaboration with Hunter Water and the University of Newcastle to investigate adaptation pilots.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. In conjunction with actions OG-3 to OG-6, research and potential pilot studies to be undertaken on raising or improving assets i.e. raising roads, or properties or improving training walls/protection measures – and promoting the use of flood resilient or adaptable design/construction 2. In conjunction with actions PDC-2, review Development Control Plan and potential design precinct control plan which promotes the research, piloting, and use of flood resilient/adaptable design and construction 3. Pilot residential or commercial development with flood resilient or adaptable designs Refer F2010/02394/02 and F2010/02394/07 Doc No. TBC
Location/Focus	Various – priority areas/locations to be agreed across all suburbs
Priority/Timing	Immediate: 1 – 4 years and ongoing.
Trigger considerations	N/A
Hazards addressed	Various: predominantly tidal inundation, catchment flooding, groundwater and storm surge and east coast lows
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, Hunter Water, University of Newcastle (UoN), local residents in selected areas, government and non-government organisations, community and business groups, TBC
Project control group and/or contacts	Council (ES, various TBC), local resident working group, Hunter Water, UoN
Est. cost	$0.1 - $0.2M pa
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA conducted as part of LAP
Tested by CBA Y/N – comments	Not specifically assessed as an option, however, the CBA included a strong recommendation that further research and piloting of interrelated/interdependent adaptation options be undertaken. Community exhibition also flagged the need for innovative pilots water, sewerage and drainage
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic (land use) planning documents
Summary: This action will assist with broadening potential adaptable engineering options for the LAP area. This will assist to ensure ongoing investment in the area while reducing potential future risks to new developments	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Piloting, research and innovation action description template – PRI7: **Continue to investigate the suitability of existing, new and/or revised trigger levels to inform the timely implementation of agreed adaptation actions**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Review and assess the suitability of existing information on community tolerances and potential trigger levels determined in the economic feasibility study 2. Undertake a detailed community investigation on tolerance of flooding for properties, business precincts, environmental areas, and recreational areas. If possible, the survey should be repeated following the onset of a major hazard. This might assist with determining if, and by how much tolerances change following the impact of such an event 3. Based on survey data and predicted impact of hazards, determine trigger levels for various high cost actions and ongoing maintenance and management. This could be done by targeting high risk areas and determining trigger levels with the involvement of residents from those areas – in conjunction with proposed research for actions OG-4 to OG-6. Ensure monitoring and reporting initiatives are effective in driving timely implementation of actions tied to early intervention / established triggers Refer F2010/02394/02 and F2010/02394/07 Doc No. TBC
Location/Focus	Various – priority areas/locations to be agreed across all suburbs
Priority/Timing	Immediate: 1 – 4 years and ongoing
Trigger considerations	N/A
Hazards addressed	Various: predominantly tidal inundation, catchment flooding, groundwater and storm surge and east coast lows
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, local residents in selected areas, government and non-government organisations, community and business groups, universities, TBC
Project control group and/or contacts	Council (ES, various TBC), local resident working group, TBC
Est. cost	$0.1 - $0.2M pa
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA conducted as part of LAP
Tested by CBA Y/N – comments	Not specifically assessed as an option, however, the CBA included a strong recommendation that further research and investigation of trigger levels be undertaken. Draft LAP exhibition identified need for triggers around stormwater/ drainage maintenance.
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic (land use) planning documents
Summary: Trigger levels are essential to avoid maladaptation, particularly for high cost/high risk actions. Potential trigger levels are not currently well understood, although there were preliminary triggers used as the basis for conducting the economic feasibility study (CBA). There needs to be further investigation of community tolerances, and the time it would take to implement high cost/high risk adaptation actions to assist with the determination of timely and effective trigger levels	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Advocacy and engagement action description template – AE1: **Enhance collaboration with utilities providers such as Hunter Water, Origin Energy, AGL, Telstra and others, ensuring that infrastructure potentially affected by sea level rise is identified and considered in forward planning to ensure timely adaptation**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Inception meeting with Transport for NSW within the first year of the LAP 2. In consultation with Transport for NSW, investigate potential scope and timing for upgrading Pacific Highway, and its use as a barrier mechanism between Black Neds Bay and Swansea CBD 3. In consultation with Transport for NSW, investigate requirements and data gaps for raising the Pacific Highway and its use as a barrier mechanism between Black Neds Bay and Swansea CBD Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	Pacific Highway / Bowman Street, Swansea CBD
Priority/Timing	Immediate: 1 – 4 years and ongoing. Inception meeting within 1st year of LAP. Timing for the raising of Pacific Highway to be assessed on further discussions with the Transport for NSW
Trigger considerations	Assessed on further discussions with the Transport for NSW and ongoing hazard analysis, monitoring and review.
Hazards addressed	Various: East coast lows and storm surge, channel dynamics, groundwater, and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, community residents, business and industry, consultants and engineering advice, Transport for NSW, other State Departments, State Emergency Service, utilities sector
Project control group and/or contacts	Council (ES, various TBC), Transport for NSW, TBC
Est. cost	TBC
Funding Source	Transport for NSW, Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA
Tested by CBA Y/N – comments	Not specifically assessed as an option, however, identified as part of the LAP Working Group options. CBA included a strong recommendation that further research and piloting of interrelated/interdependent adaptation options be undertaken. Reinforced by community submissions during public exhibition
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council, the Community and Transport for NSW, in accordance with relevant guidelines and NSW legislation
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Refer to Comms and Engagement Plan F2010/02394/02
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: This action is aimed at ensuring all stakeholders know the impacts and the proposed adaptation approach of local government and the community. Early collaboration will ensure that stakeholder asset planning schedules and potential road, asset, and property raising can be aligned.	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Advocacy and engagement action description template – AE2: **Enhance collaboration with utilities providers including Jemena, Origin Energy, Telstra and others ensuring that infrastructure potentially affected by sea level rise is identified and considered in forward planning to ensure timely adaptation**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Within 1st year of LAP, design an engagement plan for utility providers to ensure collaboration 2. In consultation with service providers, identify assets at high risk and investigate potential coordinated approach to raising Utility, Community and Council assets 3. Ensure there are opportunities for consultation and collaboration with the community, and other stakeholders such as the State Government Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	Areas considered at high risk of inundation, particularly those where utility assets may be impacted. To be determined in scoping studies in consultation with various utility providers
Priority/Timing	Immediate and ongoing: 1 – 4 years and ongoing. Engagement plan within 1st year of LAP. Within 4 years scope for further investigations on scheduling, design, and upgrades
Trigger considerations	Assessed during further consultation
Hazards addressed	Various: East coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, utilities providers, community residents, business and industry, consultants and engineering advice, TBC
Project control group and/or contacts	Council (ES, AM, various TBC), utilities providers
Est. cost	TBC
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA
Tested by CBA Y/N – comments	Considered as an option and whilst not resulting in a strong benefit cost ratio in the immediate term, the CBA included a strong recommendation that further research and piloting of interrelated/interdependent adaptation options be undertaken
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council, the Community and utilities providers
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: This action will assist with broadening potential adaptable engineering options for the LAP area. This will assist to ensure ongoing investment in the area while reducing potential future risks to new developments and community wellbeing. Considered an important medium-long term strategy by Council and members of the LAP working group.	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Advocacy and engagement action description template – AE3: **Targeted advocacy for community and industry to take up of flood resilient and adaptive residential and commercial buildings design and construction in the area and promote pilots and case studies**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Ensure ongoing community awareness in accordance with actions GF1 and AE5. 2. Investigate community and industry led adaptation and resilience construction projects in Australia and internationally 3. Communicate findings with the community and relevant industry partners to understand feasibility, viability and acceptance of community and industrial led projects in the construction industry 4. Seek grant funding opportunities for pilot/case studies for innovative constructions for adaptation and resilience 5. Collaborate with relevant Council departments and State Government with regards to best practice for promoting innovative construction and planning strategies incorporating climate change adaptation measures Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	Areas considered at high risk of inundation, particularly those where built assets may be impacted. To be determined in scoping studies in consultation with stakeholders
Priority/Timing	Immediate and ongoing: 1 – 4 years and ongoing. Engagement plan within 1st year of LAP. Within 4 years scope for further investigations on scheduling, design, and upgrades
Trigger considerations	Assessed during further consultation
Hazards addressed	Various: East coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, development and building sector, SES, community residents, business and industry, consultants and engineering advice, TBC
Project control group and/or contacts	Council (ES, AM, various TBC), utilities providers
Est. cost	TBC
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and included in the MCA
Tested by CBA Y/N – comments	Considered as an option in CBA and whilst not resulting in a strong benefit cost ratio in the immediate term the CBA included a strong recommendation that further advocacy, research, piloting of interrelated/interdependent adaptation options be undertaken
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council, the Community and other stakeholders
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. MERI; and as part of regular review and update of Council's strategic planning documents
Summary: This action will assist with broadening potential adaptable engineering options for the LAP area. This will assist to ensure ongoing investment in the area while reducing potential future risks to new developments and community wellbeing. Considered an important medium-long term strategy by Council and members of the LAP working group	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Advocacy and engagement action description template – AE4: **Enhance collaboration with the community, State agencies and NGO's to build community resilience including but not limited to emergency preparedness and response to ensure community resilience is maintained and enhanced**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Ensure ongoing community awareness in accordance with actions AE-4 and GF-1 2. Investigate community led adaptation and resilience projects in Australia and internationally in areas such as disaster management, disaster risk reduction, and capacity building 3. Communicate findings with the Community and relevant stakeholders to understand feasibility, viability and acceptance of community led projects. 4. Seek grant funding opportunities for pilot/case studies for innovative adaptation and resilience 5. Collaborate with relevant Council departments, State Government, Hunter Water and other stakeholders with regards to disasters 6. Ensure ongoing communication to the community by relevant stakeholders that details areas of emergency planning, hazard assessments, emergency management, emergency response measures, and capacity building Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	All areas of the LAP
Priority/Timing	Immediate and ongoing
Trigger considerations	Adaptive around planning and preparation and in response to events. Ongoing assessment during further consultation
Hazards addressed	Various: east coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, SES, community residents, business and industry, Hunter Water, TBC
Project control group and/or contacts	Council (ES, CP-SE, various TBC), NSW Government, SES, others TBC
Est. cost	TBC
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and discussed in the MCA – referred directly to LAP as a low-regrets essential recommendation
Tested by CBA Y/N – comments	Whilst not tested, the CBA recommended integrating community and stakeholder engagement in partnership with other actions. Sewerage surcharges during storm events identified as a key focus of concern during exhibition. Include strategies to address in emergency preparedness and response
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council and the community
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action; in line with actions AE3 and GF1
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: This action seeks to enhance connections between the community and relevant disaster preparedness, resilience and response organisations. This is to ensure that disaster management is community led with input from relevant technical disaster professionals	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Governance and Funding action description template – GF1: **Maintain and enhance community participation and engagement measures to ensure an ongoing two-way relationship with Council and the community in the implementation and review of the LAP.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Codesign of LAP implementation communications and engagement strategy 2. Regular updates to the community on changes to hazards, risks, implementation of the LAP, and relevant scientific information as captured in MMR actions 3. Regular presentations and/or communications to the community by professionals during and on completion of contracted works 4. Regular updates by Council staff (such as the LEMO or similar) with the SES on developments in emergency management and response 5. Regular updates on media channels and the Shape Lake Macquarie LAP page(s) detailing developments in implementing the LAP 6. Council to provide multiple options for the community to respond to new information and engage with projects – including assistance in implementation. 7. Supporting a collaborative LAP working group for the ongoing implementation and review of the LAP Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	All areas of the LAP.
Priority/Timing	Immediate and ongoing
Trigger considerations	Adaptive around planning and preparation and in response to events. Ongoing assessment and review pending further engagement.
Hazards addressed	Various: east coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment
Stakeholders	Council, community residents, business and industry, State government and non-government organisations, SES, others TBC
Project control group and/or contacts	Council (ES, CP-SE, various TBC), NSW Government, SES, others TBC
Est. cost	TBC
Funding Source	Council, potential grant funds, others TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and discussed in the MCA – referred directly to LAP as a low-regrets essential recommendation
Tested by CBA Y/N – comments	Whilst not tested, the CBA recommended integrating community and stakeholder engagement in partnership with other actions
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council and the community
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action; in line with actions AE3 and AE4
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: This action seeks to continue and enhance the collaborative relationships between Council and the community; particularly local residents, business and industry and other key stakeholders involved in community resilience and climate change adaptation. Highlighted as a key immediate and ongoing (long term) strategy by Council and members of the LAP working group and raised during community exhibition. Appreciation of work done by current and past members of working group. Need to maintain community involvement/participation	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Governance and Funding action description template – GF2: **In accordance with the NSW Coastal Management Framework, ensure ongoing coordination between all levels of Government for consistent and uniform management of coastal resources to enable LAP implementation**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Integrate LAP principles and actions in engagement with State Government including, but not limited to, scoping, development and implementation and review of the current Coastal Management Program (CMP) 2. Ensure cross-departmental coordination and ownership of the LAP. This could be achieved by regular department updates, inclusion in community engagement and in discussions with State and/or professional consultants with regards to implementing actions or review of the LAP 3. Actively consult, advise, and/or seek co-design opportunities for projects being undertaken by State Departments or other Council departments that could assist in achieving the actions in this LAP. Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	All areas of the LAP
Priority/Timing	Immediate and ongoing
Trigger considerations	Adaptive around planning and preparation and in response to events. Ongoing assessment and review pending further engagement
Hazards addressed	Various: east coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, community residents, business and industry, State government and non-government organisations, SES, others TBC
Project control group and/or contacts	Council (ES, CP-SE, various TBC), NSW Government, SES, others TBC
Est. cost	TBC
Funding Source	Council, potential grant funds, other TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and discussed in the MCA – referred directly to LAP as a low-regrets essential recommendation
Tested by CBA Y/N – comments	Whilst not tested, the CBA recommended integrating community and stakeholder engagement in partnership with other actions
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council and the community
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action; in line with actions AE3 and AE4
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: The aim of this action is to ensure that this LAP is not operated as within a "silo" style governance and there is cross-departmental support within Council for the initiation, design and implementation of actions. Furthermore, this action aims to ensure State agencies are collaborated with and included in the LAP actions	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

Governance and Funding action description template – GF3: **Investigate the feasibility of establishing a capital reserve and/or other funding or resourcing measures consistent with the NSW Local Government Act and Coastal Management Program to meet current and emerging LAP recommendations and future climate change adaptation programs.**	
Detailed description/scope, including implementation actions (and folder number if available)	1. Ensure integration of LAP actions into Council's 10, 4 and 1 year strategic, delivery and operational plans and the LM Environmental Sustainability Strategy and Action Plan 2. Investigate funding measures available at Council to identify, model and meet the likely future costs of funding the LAP 3. Actively seek and promote for Council resources to provide adequate planning and implementation of LAP actions 4. Engage with relevant government and non-government organisations to identify and procure funding to ensure implementation of the LAP 5. Seek continued grant funding to undertake further investigations as identified in the LAP 6. Investigate private and public opportunities for innovative mechanisms for funding and resourcing Refer F2010/02394/02 and F2010/02394/07. Doc No. TBC
Location/Focus	All areas of the LAP
Priority/Timing	Immediate and ongoing
Trigger considerations	Adaptive around planning and preparation and in response to events. Ongoing assessment and review pending further engagement
Hazards addressed	Various: east coast lows and storm surge, channel dynamics, groundwater, lake flooding and tidal Inundation
Enterprise Risk Framework considerations:	Essential: consider all aspects of ERF in Sycle project risk assessment.
Stakeholders	Council, community residents, business and industry, State government and non-government organisations, SES, others TBC
Project control group and/or contacts	Council (ES, CP-SE, IP, DAC, various TBC), NSW Government, SES, others TBC
Est. cost	TBC
Funding Source	Council, potential grant funds, other TBC
LAP Multi-criteria Assessment (MCA) result?	Identified by community and discussed in the MCA. Considered in the MCA and CBA brief and flagged as a required LAP action
Tested by CBA Y/N – comments	Considered in CBA within the context of the distribution analysis and proposed funding model – identified as key recommendation arising from the MCA and CBA
Planning considerations and other strategic linkages	Yes: Coastal Management Framework. Refer CBA and Hazard Report – also LM CZMP (2015) and LM CMP (in preparation). Consider aspects related to LM LEP and DCP. Long-term planning with a coordinated approach between Council, government and non-government organisations and the wider community
Communications and engagement aspects	Essential: local residents, business and industry, government and non-government organisations. Comms and Engagement Plan to be developed as part of action; in line with actions AE3, GF1 and AE4
Monitoring, Evaluation, Review and Improvement (MERI) aspect	Yes; annual review and reporting as per MMR3; incl. in ESSAP and SOE report. As part of regular review and update of Council's strategic planning documents
Summary: This action seeks to provide clarity and surety around long term funding to implement the current LAP in collaboration with the community. This action was highlighted as a key immediate and ongoing (long term) strategy by Council and members of the LAP working group. Also flagged during the community exhibition - along with the need for Council and the community to lobby State and Federal government for action and funding to support climate change mitigation and adaptation	
Reference Documents:	- Coastal Management Framework - CBA - LM CZMP - LM CMP

List of abbreviations

AE action	LAP action related to advocacy and engagement
AEP	Annual Exceedance Probability e.g. a 1% AEP storm event has a 1% probability of occurring in any given year ie: 1 in 100
AHD	Australian Height Datum (measured in metres)
CBA	Cost Benefit Analysis
CIE	Centre for International Economics
Council	Lake Macquarie City Council
DPIE	NSW Department of Planning, Industry and Environment
ECL	East Coast Low (low pressure storm system)
ERF	Lake Macquarie City Council's Enterprise Risk Management Framework ensuring relevant risks are identified, assessed, controlled and regularly reviewed
GF action	LAP action related to governance and funding
HW	Hunter Water
IPCC	The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change: https://www.ipcc.ch/
IP&R	Integrated Planning and Reporting Framework underpinning community and Council planning for a period of at least 10 years (incl. 10, 4 and 1 year plans)
LAP	Local adaptation plan
LGA	Local Government Area
LM DCP	Lake Macquarie Development Control Plan
LM ESSAP	Lake Macquarie Environmental Sustainability Strategy and Action Plan
LM LEP	Lake Macquarie Local Environmental Plan
MCA	Multi-criteria Analysis
MERI	Monitoring, evaluation, review and improvement
MMR action	LAP action related to maintenance, monitoring and reporting
OGW action	LAP action related to on-ground works
PPC action	LAP action related to planning and development control
PRI action	LAP action related to piloting, research and innovation
RCP	Representative Concentration Pathway. IPCC uses 4 different greenhouse gas emission scenarios (RCP2.6, RCP4.5, RCP6.0 and RCP8.5) as the basis for climate predictions/projections: https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html
SS	Storm Surge
Sycle	Reference to Lake Macquarie Council's project management support tool and framework
TRIM document number and/or PM folder number	Reference to Council's Electronic Document Management System
UoN	University of Newcastle
WG	The LAP working group – consisting of resident volunteers, Council and NSW Department of Planning, Industry and Environment staff representatives

APPENDIX 2

Community Engagement Strategy and Activities

Appendix 2:
Community Engagement Strategy and Activities

Section 1 in Volume 1 of the LAP provided a brief summary of the co-design process and community engagement strategy that informed the LAP's preparation.

The following sections provide further detail on the community engagement approach, activities and materials used by Council and the LAP Working Group to engage the wider community in designing and implementing the LAP.

Contents:

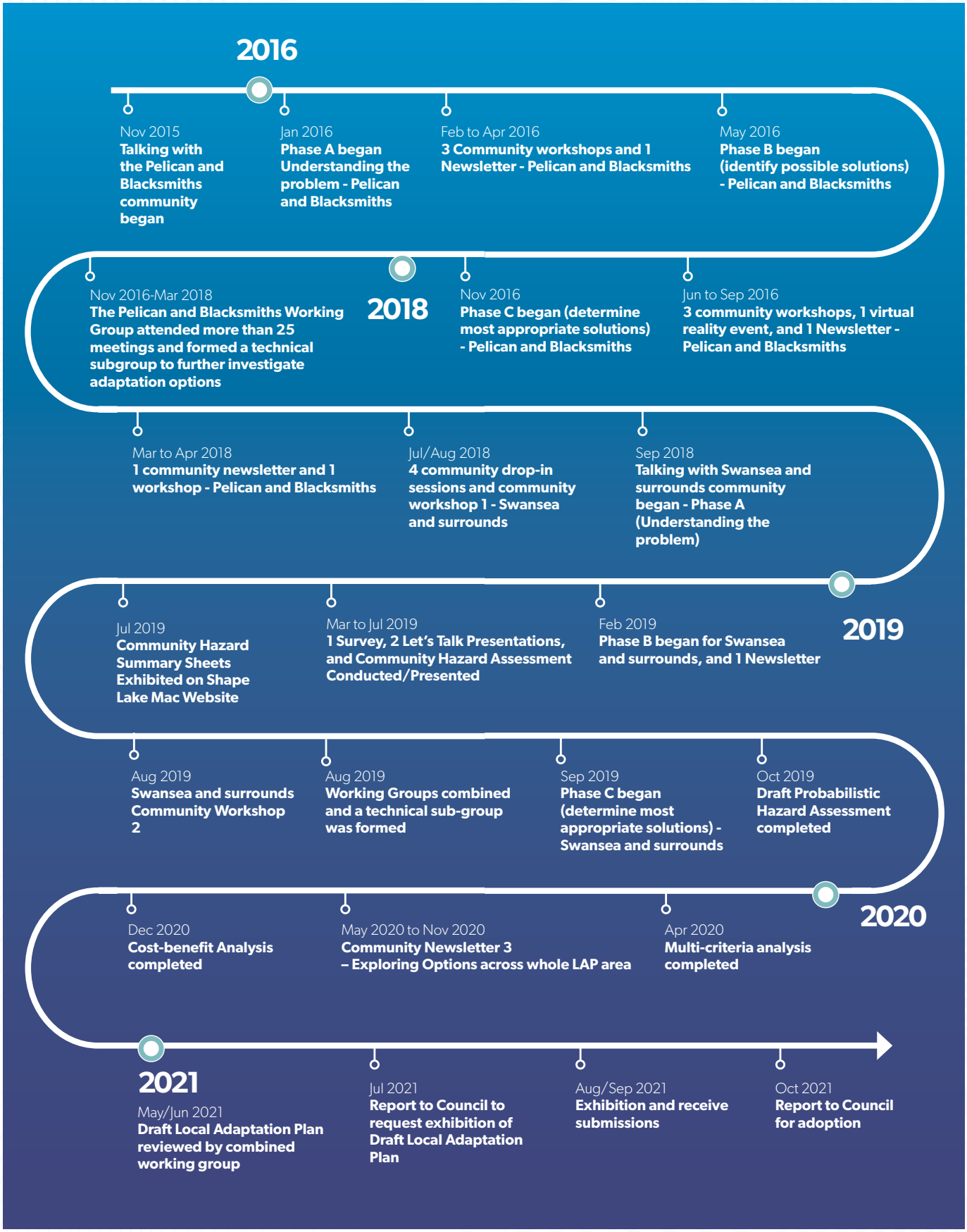
Appendix 2.1:
Communications and engagement strategy and timeline

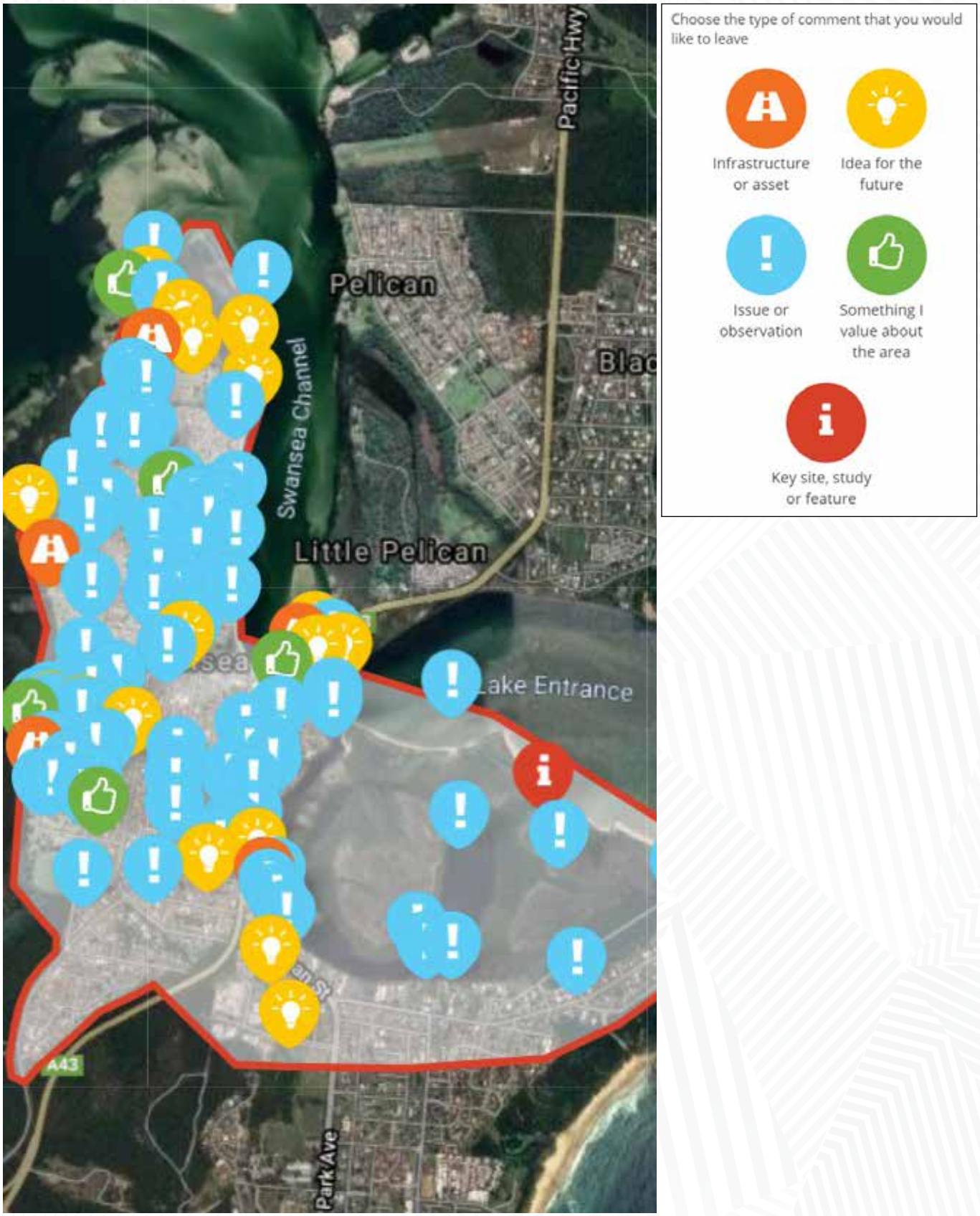
The joint Council and community LAP working group developed and used a communications and engagement strategy to work collaboratively with industry and community in achieving a customised Local Adaptation Plan for Pelican, Blacksmiths, Swansea and the surrounding areas. Key elements/steps of the communications and engagement strategy are outlined in Section 1.5 of Volume 1 of the LAP.

The objectives of the communications and engagement strategy were to:

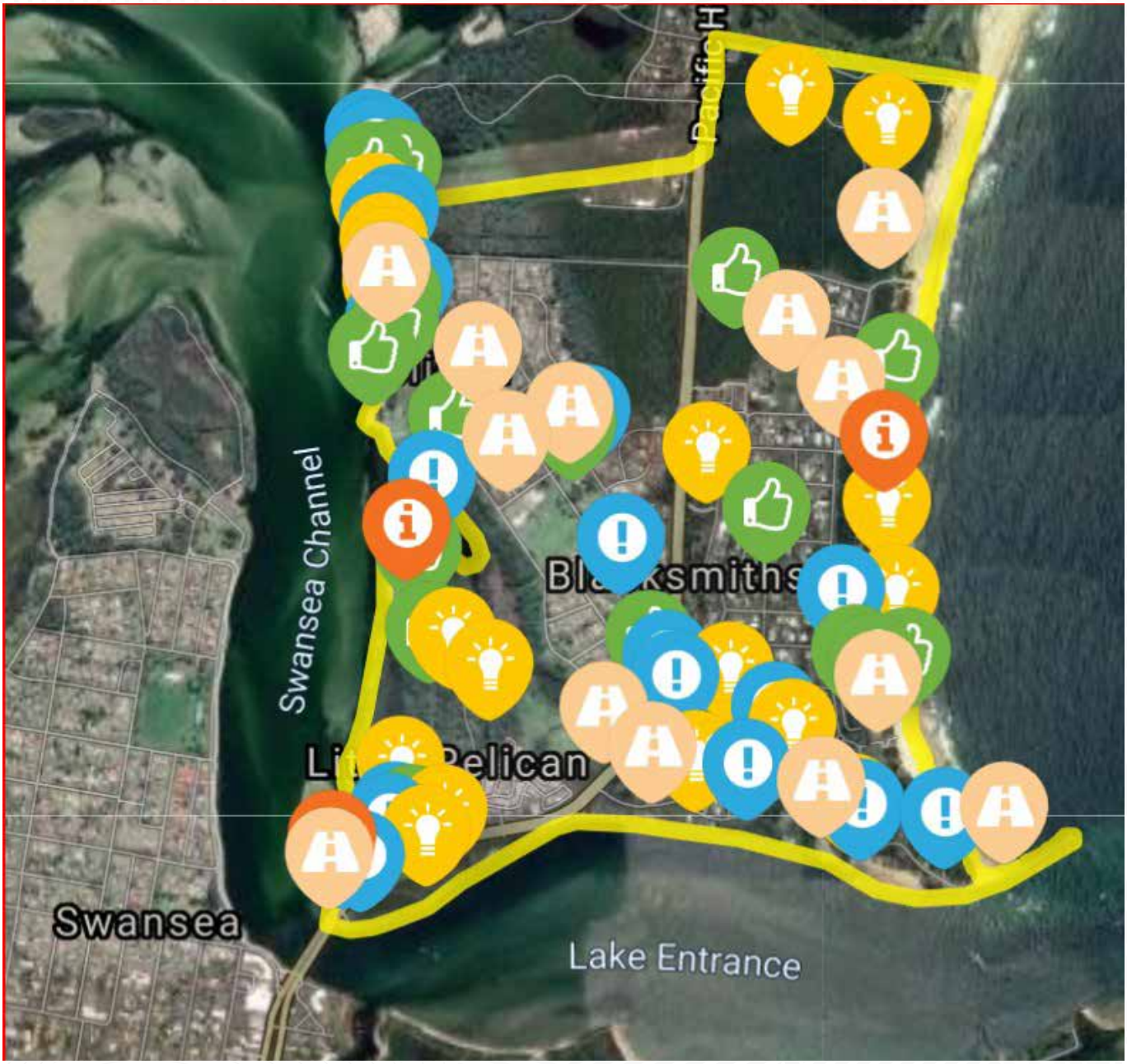
- Build trusted relationships between Council, the local community and key stakeholders.
- Be transparent in the decision-making process – making available to the community and all stakeholders, clear, accurate and up-to-date information on the Local Adaptation Plan process from beginning to end.
- Position the project as a collaborative partnership between Council and stakeholders to deliver agreed solutions that provide a benefit to the community.
- Proactively engage stakeholders about the project, including being clear about the negotiable and non-negotiable aspects.

The figure on the following page shows a timeline of key dates and activities undertaken to develop the LAP and engage the broader community in the LAP's preparation, review and eventual implementation.

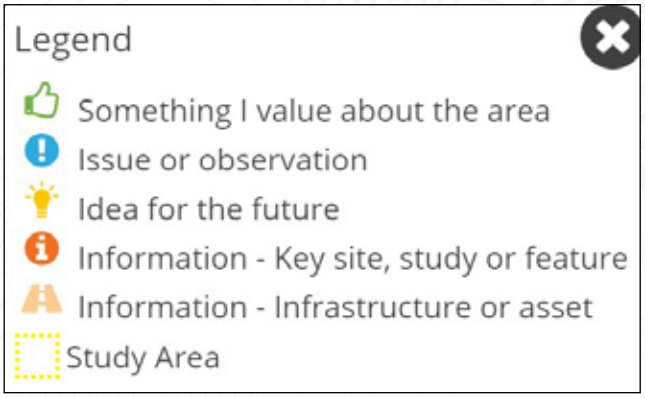

2016
Nov 2015
Talking with the Pelican and Blacksmiths community began
Jan 2016
Phase A began Understanding the problem - Pelican and Blacksmiths
Feb to Apr 2016
3 Community workshops and 1 Newsletter - Pelican and Blacksmiths
May 2016
Phase B began (identify possible solutions) - Pelican and Blacksmiths
Nov 2016-Mar 2018
The Pelican and Blacksmiths Working Group attended more than 25 meetings and formed a technical subgroup to further investigate adaptation options
2018
Nov 2016
Phase C began (determine most appropriate solutions) - Pelican and Blacksmiths
Jun to Sep 2016
3 community workshops, 1 virtual reality event, and 1 Newsletter - Pelican and Blacksmiths
Mar to Apr 2018
1 community newsletter and 1 workshop - Pelican and Blacksmiths
Jul/Aug 2018
4 community drop-in sessions and community workshop 1 - Swansea and surrounds
Sep 2018
Talking with Swansea and surrounds community began - Phase A (Understanding the problem)
Jul 2019
Community Hazard Summary Sheets Exhibited on Shape Lake Mac Website
Mar to Jul 2019
1 Survey, 2 Let's Talk Presentations, and Community Hazard Assessment Conducted/Presented
Feb 2019
Phase B began for Swansea and surrounds, and 1 Newsletter
2019
Aug 2019
Swansea and surrounds Community Workshop 2
Aug 2019
Working Groups combined and a technical sub-group was formed
Sep 2019
Phase C began (determine most appropriate solutions) - Swansea and surrounds
Oct 2019
Draft Probabilistic Hazard Assessment completed
Dec 2020
Cost-benefit Analysis completed
May 2020 to Nov 2020
Community Newsletter 3 – Exploring Options across whole LAP area
Apr 2020
Multi-criteria analysis completed
2020
2021
May/Jun 2021
Draft Local Adaptation Plan reviewed by combined working group
Jul 2021
Report to Council to request exhibition of Draft Local Adaptation Plan
Aug/Sep 2021
Exhibition and receive submissions
Oct 2021
Report to Council for adoption



Social pinpoint map for Swansea/Surrounds provided on Shape Lake Mac site at LAP initiation.



Social pinpoint map for Pelican/Blacksmiths provided on Shape Lake Mac site at LAP initiation.



Blacksmiths Beach Tides Rains Drains Tour 2016.

Tides, Rains and Drains Tour Pelican and Blacksmiths 2016.

Pelican Blacksmiths Virtual Reality Visualisation Session June 2016.

Tides, Rains and Drains Tour Pelican and Blacksmiths 2016.

Coles drop-in for Adapting Swansea/Surrounds LAP, August 2018.

Initial community meeting for Adapting Swansea/surrounds LAP, August 2018.

Appendix 2.2: Let's Talk events and activities

Let's talk: Hazards, risks and precincts in adaptation planning

27 Sep 2018

Join local representatives and Council staff for an afternoon to talk local adaptation planning and learn from the experiences of our previous plans.

Monday 15 October, 3-4.30pm

The Swansea Centre, 228 Pacific Highway, Swansea

Explore different approaches to adaptation planning and ways to custom the plan to suit the local community's unique circumstances. The talk will highlight preliminary

Continue reading...

Upcoming talks in October for planning for future flood risks

27 Sep 2018

Let's talk: Planning for Future Flood Risks

Join expert Dennys Angove, local community representatives and Council at two upcoming information talks to better understand the science of climate change and learn more about adaptation planning through the experience of previous plans.

Understanding the Science of Climate Change with Dr

Continue reading...

Let's talk: Understanding the science of climate change

27 Sep 2018

Understanding the science of climate change

Join Dr Dennys Angove for an afternoon to explore the science of climate change.

Wednesday 10 October, 1-2.30pm

The Swansea Centre, 228 Pacific Highway, Swansea

Continue reading...

Let's Talk sessions cover flooding, natural disasters in Lake Mac

by kmarples, 24 Apr 2019

Expert talks held in Lake Macquarie next month will help shed light on flooding and tidal inundation risks in Pelican, Blacksmiths and Swansea, and how residents can prepare for natural disasters.

Let's Talk: Understanding the Probabilistic Hazard and Damages Assessment for Pelican, Blacksmiths and Swansea with Dr David Wainwright

by kmarples, 05 Apr 2019

Join Dr David Wainwright for an evening to examine the findings of the Probabilistic Hazard and Damages Assessment for Pelican, Blacksmiths and Swansea.

Monday 13 May, 5.30-7pm

The Swansea Centre, 228 Pacific Highway, Swansea

Probabilistic Hazard and Damages Assessment

Council engaged Salients Pty Ltd to undertake a probabilistic hazard and damages assessment to examine

Continue reading...

Let's Talk: Community evacuation plans and safety during natural disasters with the SES

by kmarples, 05 Apr 2019

Join local SES and Council representatives for an evening to review community evacuation plans and how to prepare for natural disasters.

Tuesday 7 May, 5.30-7pm

The Swansea Centre, 228 Pacific Highway, Swansea

The presentation will include information about forming effective community evacuation plans, proactive safety actions during natural disasters and the process to develop

Continue reading...

Let's Talk: Understanding the Cost Benefit Analysis for Local Adaptation Planning

18-Nov-2020

Join Council representatives and guests from the **Centre for International Economics** for a session sharing insights and recommendations from the Cost Benefit Analysis (CBA) recently completed, which will inform the Local Adaptation Plan (LAP).

Session details:

- Monday 30 November 11.00am - 12.15pm
- Participants may attend online or in-person (attendance in-person is capped at 10 people due to COVID)
- **Registration is essential** - visit our Eventbrite webpage for venue information and to book.

What this session will cover:

Over the last year members of the joint Council and Community Working Group co-designing the Pelican, Blacksmiths and Swansea LAP have been working with consultants to prepare a CBA examining a number of potential adaptation options for the area.

Nigel Rajaratnam and Joseph Caruana from the Centre for International Economics will present:

- The LAP options examined in the CBA
- Methods and assumptions used in the analysis; and
- Results and recommendations that will help inform the LAP being developed by the Council and the community.

There will be an opportunity for a Q&A at the end of the talk.

You may submit questions beforehand to: AdaptingSwansea@lakemac.nsw.gov.au

Appendix 2.3: Community surveys

CLOSED: This survey has concluded.

Identifing Adaptation Options

Share you feedback and ideas to help us understand current flooding hazards and impacts in Swansea and identify adaptation options to address sea level rise and tidal inundation.

Complete Form

CLOSED: This survey has concluded.

Community survey

Share your feedback and ideas to help us understand current flooding hazards and risks in Swansea and plan for the future as lake and sea levels rise.

Take Survey

CLOSED: This survey has concluded.

Shorlist adaptation options

Share your feedback to help shortlist the adaptation options recommended by the Community Working Group. These options will be implemented now and in the future to manage flood risks in Swansea and surrounds.

Take Survey

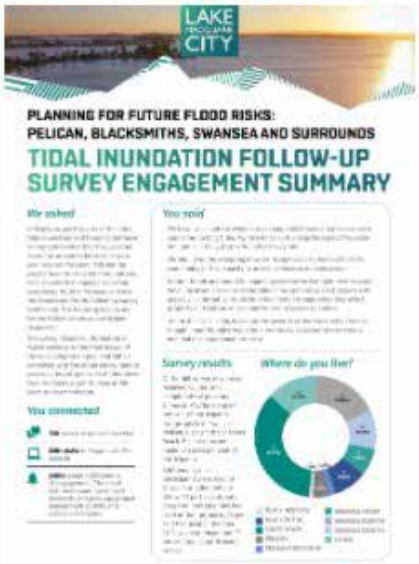
CLOSED: This survey has concluded.

Tidal inundation impacts survey

Part of the local adaptation planning process involves determining when particular actions need to be taken. This survey will help the project team understand the community acceptance and tolerance levels of tidal inundation and establish the community's threshold for potential flooding and inundation impacts. This is measured by asking how your household would accept the possible changes, such as to your lifestyle and property, access to roads and footpaths to visit shops and services, and outdoor spaces.

Take Survey

Read the latest community engagement summary



Read the latest community newsletter

Click here to learn more about the feasibility assessment

PLANNING FOR FUTURE FLOOD RISKS: PELICAN, BLACKSMITHS, SWANSEA AND SURROUNDS

TIDAL INUNDATION SURVEY ENGAGEMENT SUMMARY

We asked

During May and June, household and businesses in Pelican, Little Pelican, Blacksmiths, Swansea, Swansea Heads and Caves Beach received a project newsletter and tidal inundation tolerance survey to help Council understand community views and acceptability of potential tidal inundation impacts.

You connected

- **242** survey responses
- **1140+ visits** to project websites
- **6400+** Newsletters to letterboxes
- **5700+** reach on social media
- **2000+** Email notifications
- **18,000+** eNewsletters
- **19,000+** media/newspaper reach

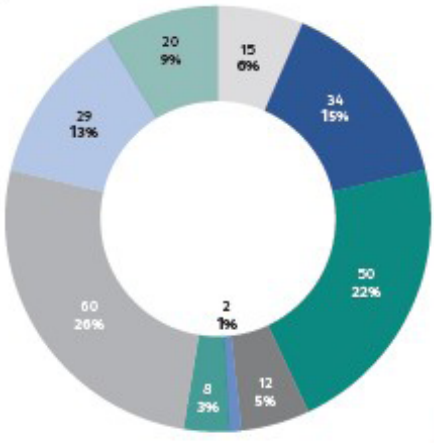
You said

- Worst storm at Pelican was 30 years ago when bulk carrier signa washed up on Stockton Beach. Water covered Pelican Park and Lake View Parade to 400mls for about 4 hours but receded by 9am. Nothing since last 30 years.
- Resident of the area for the past 45 years so I have seen some major flooding and inundation hence my acceptance of some natural interference with everyday life.
- Swansea needs to be built up at least to 450mm above current high-water level, all new builds should conform to that, current floor levels must remain, expensive but I believe it's the only way to save Swansea and I feel would be enough to keep the suburb open even in bad weather.
- Bowman St will still need to be raised to allow residents to enter/leave Caves Beach soon! Already floods on high tides.

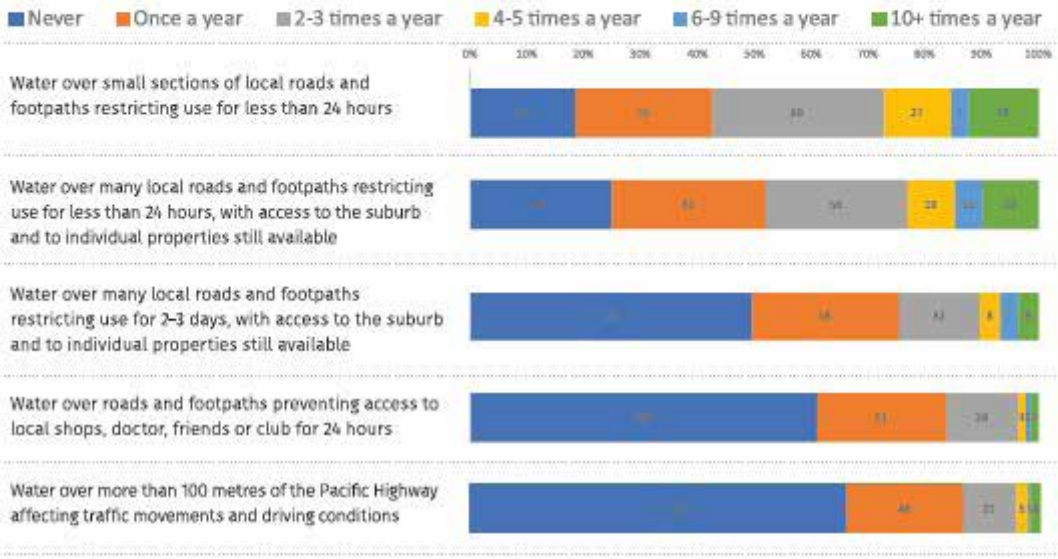
Survey results

Of the 242 survey responses received, almost all were property owners and/or residents. Only 11 people identified as part of the business sector.

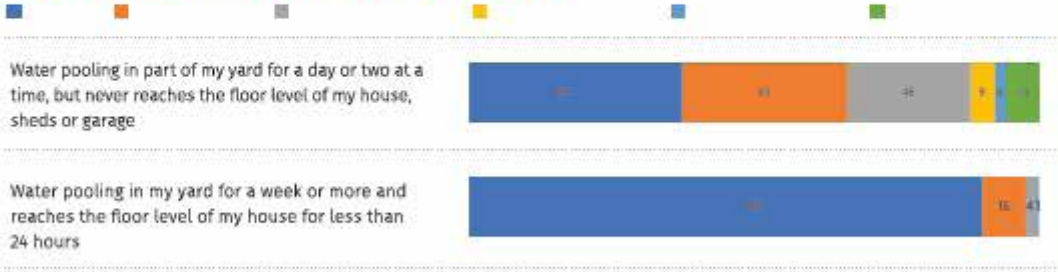
Where do you live?



Roads and Footpaths



Lifestyle and Private Property



Commercial and Public Spaces

Next steps

The information already received is highly valuable to gauge our communities' thoughts on potential tidal inundation impacts.

With this insight, we are now seeking more information from participants about occurrences of flooding and acceptability of infrequent inundation events, such as once every 10, 20 or 50 years.

The information captured in the surveys will help direct the cost benefit and distribution analysis for the proposed adaptation options considered jointly by Council, the community working group and local community.

PLANNING FOR FUTURE FLOOD RISKS: PELICAN, BLACKSMITHS, SWANSEA AND SURROUNDS

TIDAL INUNDATION FOLLOW-UP SURVEY ENGAGEMENT SUMMARY

We asked

In May/June, participants of the initial tidal inundation and flooding tolerance survey commented that they selected 'never' as an option because 'once a year' was too frequent. This led the project team to consider more options, such as potential impacts occurring once every 10, 20 or 50 years and was the foundation for the follow-up survey held in July. The following results are for the follow-up survey participant responses.

The survey response information is highly valuable to the final stages of the local adaptation plan and will be combined with the initial survey data to provide a broad spectrum of tolerances from 10+ times a year to once in 100 years to never tolerated.

You connected

168 survey responses received

336+ visits to Shape Lake Mac website

2300+ Email notifications of engagement. The email lists were made up of local residents and previous project engagement activity and survey participants.

You said

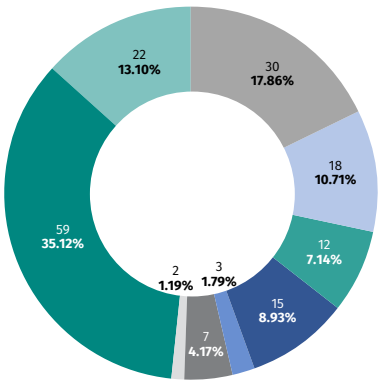
- We have twice had the whole street completely flooded, both times were connected to King Tides. My Street has curb and guttering but the water still pools in the gutters often after heavy rain.
- We should not be accepting of water rising that risks the health of the community, or the capacity to access services in an emergency.
- Natural floods are bound to happen given that we live right next to water. Small inconveniences are acceptable in my opinion i.e. road closure with access via alternative routes but I feel more strongly when they affect property and can cause cost and/or loss of access to homes.
- I think the scale is fair, based on the severity of the flood risks. I feel as though minor flooding would be more widely accepted where there is minimal risk to personal property.

Survey results

Of the 168 survey responses received, 60 per cent completed the previous survey in May/June and 87 per cent of participants own property in Swansea, Pelican, Blacksmiths or Caves Beach. Business owners made up seven per cent of participants.

Additionally, most participants were aged 51-70 years or older and out of the 151 participants who answered how long they had lived at their property, 26 per cent had lived in the area 21-30 years or longer and 57 per cent indicated 10 years or less.

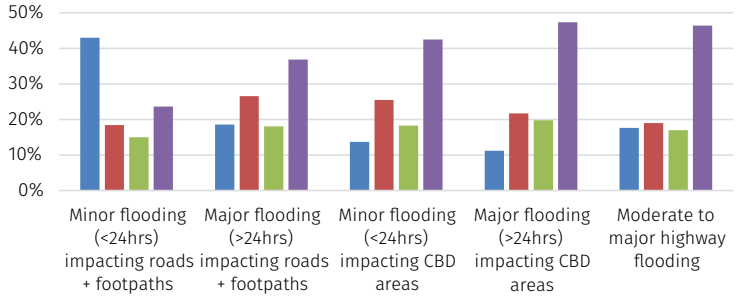
Where do you live?



The following tables show participant tolerances towards tidal inundation and flooding on roads, property and recreational areas/car parks, respectively.

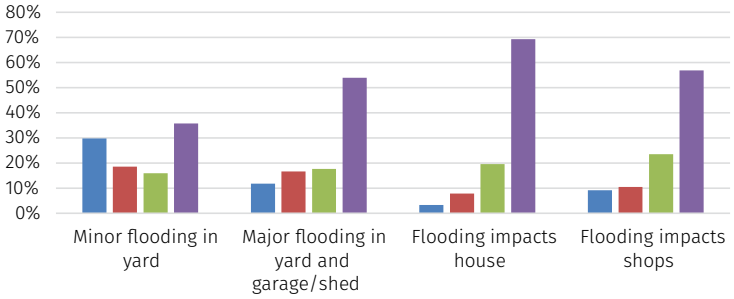
Tolerance for flooding on roads and footpaths

- Tolerant (up to once a year)
- Less tolerant (once 20 to 100 years)
- Some Tolerance (once 5 to 10 years)
- No tolerance



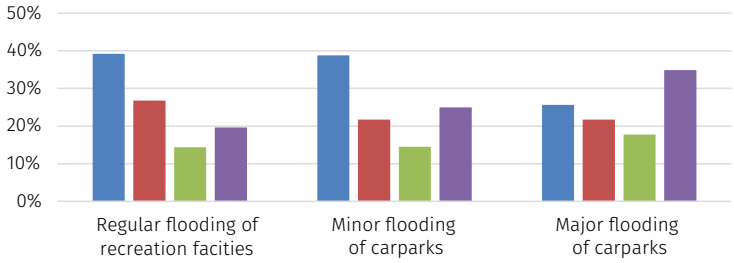
Tolerance for flooding at property

- Tolerant (up to once a year)
- Less tolerant (once 20 to 100 years)
- Some Tolerance (once 5 to 10 years)
- No tolerance



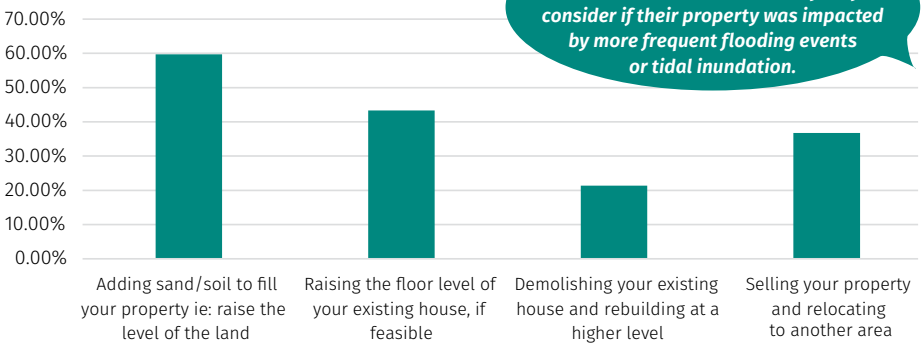
Tolerance for flooding at recreational facilities or carparks

- Tolerant (up to once a year)
- Less tolerant (once 20 to 100 years)
- Some Tolerance (once 5 to 10 years)
- No tolerance



What would you do if flooding was more frequent?

The survey also asked participants to consider what actions they may consider if their property was impacted by more frequent flooding events or tidal inundation.



Next steps

The information received is highly valuable to gauge our communities' thoughts on potential tidal inundation impacts and will help direct the cost benefit and distribution analysis for the proposed adaptation options considered jointly by Council and the Community Working Group.

The Local Adaptation Plan for Pelican, Blacksmiths, Swansea and Surrounds is now being developed. The final tool to assist this process is the Cost Benefit and Distribution Analysis, which is almost complete and expected to be presented to the community in September. The Local Adaptation Plan will follow late 2020/early 2021.

Appendix 2.4: Community newsletters

Pelican Blacksmiths Newsletters

Have your say

Planning for future flood and coastal risks

Pelican and Blacksmiths

Newsletter 1 – February 2016

Help plan for the future

Living by the coast and lake is a great lifestyle, and it is important that we manage this dynamic environment where sea and lake levels are gradually rising. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in fifty to one hundred years, so we have to plan for the future now.

Sea levels are rising gradually at a rate of around 2.6mm per year in the lake and off the coast of NSW. Based on the best available information it is expected that mean sea level will rise 0.4 metres above 1990 levels by 2050 and 0.9 metres by 2100. This means the rate of sea level rise is expected to accelerate, but it also allows us to have time to plan and prepare now.

Lake Macquarie City Council met with some residents of Pelican and Blacksmiths in late 2015 to listen and talk about opportunities for the community to help plan for the future of the area. This was the start of a conversation to prepare a Local Adaptation Plan to address future flooding and sea level rise in the local area.

We collected more than 40 comments about ideas for the future, current issues or observations. We are now seeking your input into the planning process for this Pelican Blacksmiths Local Adaptation Plan.

Upcoming events

You are invited to attend three upcoming events as part of the first stage of the planning process (Phase A). We encourage you to attend all three events, if possible, as each event will offer new insights and provide different ways to get involved and have your say.

Event 1: Planning for the future – An introduction
Thursday 3 March 2016, 6-8.30pm, Swansea Belmont Surf Club
Explore the dilemma of how sea level rise would impact on future flood levels and how Council and the community can plan for the future. We will also look at feedback provided by the community to date on current issues and observations, what people value about Pelican and Blacksmiths, and ideas for the future.

Event 2: Q&A on flooding and coastal processes
Thursday 17 March, 6-8.30pm, Swansea Belmont Surf Club
Attend a question and answer session with Council staff and independent experts in coastal processes and flood risk management to learn about the effect of sea level rise on our coast and the lake. Learn about the Lake Macquarie Coastal Zone Management Plan adopted in 2015, the Lake Macquarie Waterway Flood Risk Management Study and Plan 2012, and how these relate to a Local Adaptation Plan for Pelican and Blacksmiths.

Event 3: What should a Local Adaptation Plan do?
Thursday 7 April, 6-8.30pm, Swansea Belmont Surf Club
Help develop objectives for a Local Adaptation Plan for Pelican and Blacksmiths. Subsequent community workshops will draw on these objectives to determine the most appropriate means of managing future risks.

To RSVP, visit **www.haveyoursaylakemac.com.au/futurepelicanblacksmiths** or call Council on **4921 0333.**

Snapshot of the planning process

Over the next 12 to 18 months, Council will work with the community to…

Phase A (You are here)
Understand the problem of future flooding and sea level impacts on the coast and current community concerns

Phase B
Identify possible solutions

Phase C
Determine the most appropriate solutions and prepare a draft Local Adaptation Plan

Phase D
Place the draft Local Adaptation Plan on exhibition, adopt and implement the Plan

View our online interactive map

Community Newsletter No. 1 - Phase A - Pelican and Blacksmiths

Have your say

Planning for future flood and coastal risks

Pelican and Blacksmiths

News on Pelican Boat Ramp and Channel Dredging enclosed

Newsletter 2 – July 2016

Help plan for the future

Living by the coast and lake is a great lifestyle, and it is important that we manage this dynamic environment where sea and lake levels are gradually rising. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in fifty to one hundred years, so we have to plan for the future now.

Sea levels are rising gradually at a rate of around 2.6mm per year in the lake and off the coast of NSW. Based on the best available information it is expected that mean sea level will rise 0.4 metres above 1990 levels by 2050 and 0.9 metres by 2100. This means the rate of sea level rise is expected to accelerate, but it also allows us time to plan and prepare now.

Since late 2015 we have been working with residents of Pelican and Blacksmiths to gather local knowledge and better understand the problem of ongoing sea level rise and future flooding impacts. We have collected over 100 comments about current issues and observations in the area, and ideas to manage future hazards. We are continuing to add to this knowledge bank and you can have your say online at www.haveyousaylakemac.com.au or by contacting our project team.

Over the next few months you are invited to help Council refine the list of ideas for managing ongoing sea level rise, existing and future flooding to determine the most appropriate solutions for the local area. We encourage interested residents and community to get involved in this truly collaborative process.

Project update
Activities to date:
- 3 workshops
- Question and Answer night with coastal experts
- Online issues and ideas map
- Virtual reality demonstration of future hazards
- Two drop-in information sessions

Your ideas Summary enclosed

Upcoming events

Phase B Community planning event – What are the options?
Thursday 11 August 2016, Swansea Belmont Surf Club
We've heard your ideas for how to respond to ongoing sea level rise, higher future flood levels and beach erosion in Pelican and Blacksmiths. At this event, we'll take a more detailed look at these ideas, consider where and how they could be implemented and check if there are other options that have not been suggested to date.

To RSVP, visit **www.haveyoursaylakemac.com.au/futurepelicanblacksmiths** or call Council on **4921 0333.**

Snapshot of the planning process

Over the next 12 to 18 months, Council will work with the community to…

Phase A
Understand the problem of future flooding and sea level impacts on the coast and current community concerns

Phase B (We are here)
Identify possible solutions

Phase C
Determine the most appropriate solutions and prepare a draft Local Adaptation Plan

Phase D
Place the draft Local Adaptation Plan on exhibition, adopt and implement the Plan

View our **online interactive map** visit **www.haveyoursaylakemac.com.au/futurepelicanblacksmiths**

Community Newsletter No. 2 - Phase B - July 2016

Have your say

Planning for future flood and coastal risks

Pelican and Blacksmiths

Newsletter 3 – March 2018

Helping plan for the future

As you know, living by the coast and lake is a great lifestyle, and it is important that we manage this dynamic environment where sea and lake levels are gradually rising. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in 50 to 100 years, so we have to plan for the future now.

Since our last community update, community volunteers have been working with Council to prepare a plan addressing sea level rise impacts and solutions.

What's happened so far

Following a series of meetings and workshops with the communities of Pelican and Blacksmiths in 2016, participants recommended forming a smaller Volunteer Community Planning Group to work with Council staff to prepare a Local Adaptation Plan. The Plan will address current and future inundation of land and assets from sea level rise, higher tides and higher flood levels.

Throughout 2017, the Volunteer Community Planning Group, together with Council staff, the NSW Office of Environment and Heritage and coastal expert consultants, were able to progress the Plan by scoping the geographic area and learning more about the different hazards the Plan intends to address.

The group considered potential options raised by the community in 2016, prepared a short-list of recommendations for the local area and the pathways to implement available options. The group refined the Plan objectives and a set of criteria to assess which adaptation options are feasible and best meet the needs of the community.

Now we would like your input to help us to develop the Plan further. Please join us at a workshop to further explore the next planning stage. We will be tackling the existing and future flooding issues to determine the most appropriate solutions for the local area as sea and lake levels rise.

Snapshot of the planning process

Council continues to work with the community to…

Phase A — Completed

Understand the problem of future flooding and sea level impacts on the coast and current community concerns

Phase B — Completed

Identify possible solutions

Phase C — We are here

Determine the most appropriate solutions and prepare a draft Local Adaptation Plan

Phase D

Place the draft Local Adaptation Plan on exhibition, adopt and implement the Plan

Upcoming community workshop

Wednesday 4 April 6.30–8.30pm

Swansea Belmont Surf Life Saving Club, Blacksmiths

Come along to provide feedback on the Volunteer Community Planning Group's recommended adaptation options for the area.

To RSVP, visit **shape.lakemac.com.au/futurepelicanblacksmiths** or call Council on **4921 0333.**

To find out more, visit **shape.lakemac.com.au/futurepelicanblacksmiths**

How can we adapt to changing flood and coastal conditions?

The Volunteer Community Planning Group at work

The group's progress

Your Volunteer Community Planning Group has investigated the assets, hazards and potential solutions raised by the community during 2016 and 2017.

The group has proposed a plan based on six local precincts, which will be made available online after the community workshop on 4 April 2018.

Each precinct has been investigated by the group, together with Council, to understand the hazards and develop recommended adaptation options.

Come along and provide the group with feedback on what's proposed for each precinct.

The group's journey so far...

For more details on the group's activities, visit **shape.lakemac.com.au/futurepelicanblacksmiths**

2016	Late 2016	2017	Now	Next
Phase A	Phase B	Phase C	Phase C	Phase C
Council asked the community what they value about Pelican and Blacksmiths	Community identified possible adaptation options at workshops and recommended a Volunteer Community Planning Group form and work with Council	Volunteer Community Planning Group learned about challenges and reviewed adaptation options suggested by the wider community	Volunteer Community Planning Group reports back to community on recommendations	Council will undertake a cost benefit analysis of the options

Taking a precinct approach

Pelican: active erosion occurring along the foreshore

The group is proposing recommendations for six precincts in the Pelican and Blacksmiths study area. Precincts are based on common characteristics, such as the nature of hazards affecting them and the sorts of adaptation responses. Other factors include how the land is being used, lay of the land and the drainage network.

Why adapt our precincts?

Sea levels are projected to rise at an increasing rate. Warmer temperatures are predicted to bring more frequent and intense flooding and storm events. For Pelican and Blacksmiths residential areas, this means higher tides and flood levels will increasingly affect local roads, drains and eventually private property.

Blacksmiths: Tidal inundation of Grannies Pool car park during king tide late 2017

Blacksmiths: Ungala Road debris following a flooding event

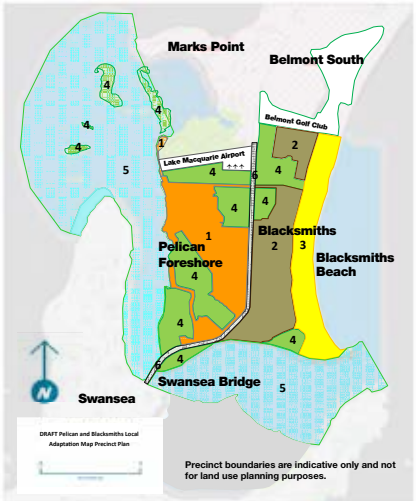
Beach recession, coastal inundation, dune-overtopping and channel migration are other issues we need to plan for and manage.

Groundwater is also predicted to rise with sea level rise, affecting drainage and other infrastructure, such as road-base and building foundations. As new homes, roads and community facilities are intended to last 50 years or more, we need to plan ahead.

Register for the community workshop at **shape.lakemac.com.au/futurepelicanblacksmiths**

What is proposed for your area and when?

Find out at our community workshop



Precinct 1 Residential land west of the Pacific Highway

Assets and infrastructure: Residences, school, shops, Little Pelican, foreshore reserve, parks, electricity and gas services, telecommunications, roads and drainage.

Hazards: Lake flooding, catchment flooding, inundation by sea level rise (from channel) and channel migration.

Precinct 2 Residential land east of the Pacific Highway

Assets and infrastructure: Residences, holiday park, sports field, school, foreshore reserve, parks, electricity and gas services, telecommunications, roads, shared pathway and drainage.

Hazards: Inundation by sea level rise (from channel), flooding and channel migration.

Precinct 3 Beach and dunes

Assets and Infrastructure: Ungala Road east – residential, Surf Life Saving Club; sewer, water, electricity, telecommunications, beach and dunes.

Hazards: Beach and dune recession, and coastal inundation.

Precinct 4 Environmental land

Assets and infrastructure: Byrnes and Boathole reserves, wetlands, seagrass beds, sand islands and habitat, recreation and economic values.

Hazards: Drowning of habitat.

Precinct 5 Channel

Assets and infrastructure: Seawall, boat ramp, groynes, breakwall, training wall, Blacksmiths boat ramp and Grannies Pool.

Hazards: Flooding, inundation and erosion.

Precinct 6 Pacific Highway and Swansea Bridge

Assets and infrastructure: Highway and bridge, sewer, water, electricity, telecommunications.

Hazards: Flooding, inundation, channel migration and water velocity.

For more details visit **shape.lakemac.com.au/futurepelicanblacksmiths**

Related local news

Pelican Sustainable Neighbourhood Group

The Pelican Area Sustainable Neighbourhood Group is helping create a sustainable future in Pelican, Blacksmiths and Marks Point, by encouraging a productive and positive culture and maintaining a healthy natural environment. The group has successfully lobbied Crown Lands for safety upgrades of the breakwall. The group also successfully lobbied Council for an upgrade of Grannies Pool as outlined in the group's Blacksmiths Action Plan.

Ongoing projects:

- Working as a dune care group in consultation with Landcare, in the southern end of Blacksmiths Beach including Grannies Pool. The group aims to ensure activities on our beaches are sensitive to the maintenance of the beach and vegetation.
- Conduct drainage audits and report issues to Council.
- Communicate with Council about beach, lake and channel erosion.

Now welcoming new members. Find out more at **sustainableneighbourhoods.org.au** or email **admin@sustainableneighbourhoods.org.au**.

2D stormwater modelling project

To assist the Pelican Blacksmiths Local Adaptation Plan, Council engaged WMA Water to carry out a two dimensional (2D) Stormwater Modelling Study for Pelican and Blacksmiths. By mapping the existing drainage system in the area and modelling a range of current and future rainfall and drainage scenarios, the model is able to give Council a clearer understanding of current and future drainage conditions and flood behaviour in the area. The study report is currently being finalised and will be available online in the near future. Watch out for an upcoming presentation event on the 2D model.

Pelican boat ramp

The tender for the design and construction of the new boat ramp and associated infrastructure was awarded to Hunter Wharf and Barge Pty Ltd. The design process is well under way with completion and approval of the final boat ramp design expected in early April.

Due to the complexities of the site and dynamic environment, time has been spent on the design process to ensure that the boat ramp is engineered to withstand the channel currents. Site demolition works begin in March 2018.

The design of the boat ramp will complement future management of the Pelican Foreshore as part of the Pelican and Blacksmiths Local Adaptation Plan.

For more information, visit **shape.lakemac.com.au/pelican-boat-ramp**

Pelican foreshore

The State Government has advised they will undertake temporary protection work on the Milano's site.

The ongoing erosion of Pelican foreshore continues to be a concern for the community, and Council has been working with various government departments to address it. Council recently received grant funds from the NSW Coastal Management Program for the design of foreshore stabilisation works in the area.

The erosion in this area is significant and will require ongoing management. In the meantime, Council is regularly inspecting the foreshore to ensure that it remains safe for public access.

Swansea local adaptation planning

The Swansea Local Adaptation Plan will be informed by the work undertaken as part of the Pelican Blacksmiths plan. Council was successful in securing funding from the NSW Government Floodplain Management Program to support development of a local adaptation plan for the Swansea community. Community engagement is expected to commence later this year. Council is currently collating background information on catchment characteristics, assets and hazards in the area, and is considering the scope of the plan.

The objective of the project is to help the Swansea community to better manage the risk of current and future flooding and tidal inundation resulting from rising lake and sea levels. The project will help provide increased certainty about future development and asset management in the area.

Want to know more?

Access the following resources on the project website for further information:

- Fact sheets
- Document library with key background studies
- Marks Point and Belmont South Local Adaptation Plan
- Information on the volunteer group's activities
- Previous project newsletters

Visit **shape.lakemac.com.au/futurepelicanblacksmiths**

You can also post questions and sign up to the project eNewsletter.

02 4921 0333 lakemac.com.au council@lakemac.nsw.gov.au lakemaccity lakemac

Box 1906 HRMC NSW 2310 126-138 Main Road, Speers Point NSW 2284

Have your say

Planning for future flood and coastal risks

Swansea

Newsletter 1 – July 2018

Help plan for the future

Living by the coast and lake in Swansea is a great lifestyle, and it is important that we manage this dynamic environment.

Expert scientific advice from the Bureau of Meteorology, the CSIRO and NSW Government agencies, predicts that sea levels will rise at a rate that will begin to affect coastal communities in coming decades. This advice is periodically updated and Lake Macquarie City Council carefully monitors climate change projections. The NSW Government requires councils to consider this advice when calculating ocean, lake and flood levels for future coastal planning.

Lake Macquarie is a tidal lake, so water levels are expected to rise at the same rate as the ocean. Swansea has many low-lying areas that are already impacted by flooding or inundation during king tides. As sea levels rise, the number of properties exposed to storm flooding and/or tidal inundation, and the frequency of these natural events, will increase.

Council is committed to keeping our community safe from climatic events into the future. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in 50 to 100 years, so we have to plan for the future now.

This information outlines how Council and the community can work together to develop a local adaptation plan for Swansea to better plan and prepare for flooding and inundation issues.

Upcoming events

Drop-in information sessions

Come along to find out more about the project and share your feedback to help us understand flooding and drainage issues in Swansea.

Saturday 28 July 8am-noon
Swansea Markets, Quinn Park, Swansea

Thursday 2 August 3-5pm
Swansea Public School Hall, Rawson Street, Swansea

Saturday 4 August 9.30-11.30am
Outside Coles, Pacific Highway, Swansea

Thursday 9 August 5-7pm
Outside Woolworths, Josephson Street, Swansea

Community workshop

Explore the impacts of sea level rise on future flood levels and how Council and the community can plan for the future to combat this complex issue.

Tuesday 14 August, 6-8.30pm
Swansea Multipurpose Centre
228 Pacific Highway, Swansea

Register for the workshop at **shape.lakemac.com.au/adapting-swansea**

If you are unable to attend the workshop you can still be involved. See over page for opportunities to contribute or to contact Council.

To find out more, visit **shape.lakemac.com.au/adapting-swansea**

View our online interactive map

Why is Council and the community planning for future flood risks?

In NSW, councils are responsible for managing local flood risks. In 2012, Council adopted the Lake Macquarie Flood Risk Management Study and Plan that identifies areas at risk of flooding and tidal inundation. This planning document recommends development of specific local adaptation plans to address flood risks in each low-lying area around the lake.

What is local adaptation planning?

Local adaptation planning aims to identify actions that Council and the community can take to respond to long-term changes in our climate. Our focus at Swansea is to prepare for the impact of increases in lake and ocean levels over the next 80 years (up to the year 2100).

Local adaptation plans focus on flooding and sea level rise and are location-specific. These plans are developed with local people to guide future land use decisions and the design and maintenance of roads, drains and other assets. Plans also consider emergency responses during storm and flood events, erosion, beach recession, lifestyle and maintaining a healthy environment.

The City's first local adaptation plan was prepared with the communities of Marks Point and Belmont South. A second plan is currently being developed with the Pelican and Blacksmiths communities. View these projects online at **shape.lakemac.com.au.**

How you can be involved

Help prepare the community's local adaptation plan for Swansea by sharing your ideas and experience of storm and tidal flooding. Your feedback helps us to understand future flooding risks and potential adaptation measures.

Have your say:

- visit a drop-in information session;
- attend the community workshop on **Tuesday 14 August;**
- complete and return the community feedback form;
- complete the survey online at **shape.lakemac.com.au/adapting-swansea;**
- ask a question online or email **council@lakemac.nsw.gov.au;**
- sign up to the project newsletter;
- share ideas or comments on our online interactive map.

Get involved! Your comments will help to inform our understanding of current flood risks in Swansea and plan for the future as lake and sea levels rise.

Example of Council's online interactive map.

Register for the community workshop at **shape.lakemac.com.au/adapting-swansea**

02 4921 0333 lakemac.com.au council@lakemac.nsw.gov.au lakemaccity lakemac

Adapting Swansea Community Newsletter 1

Have your say

Planning for future flood and coastal risks

Swansea

Newsletter 2 – February 2019

Lake Macquarie City Council is committed to collaborating with the community to provide a safer community now and in the future.

This is the second newsletter for residents outlining how the community and Council are working together to develop a local adaptation plan to address current and future hazards in Swansea.

Why plan for future flood risks and sea level rise now?

As you know, living by the coast and lake is a great lifestyle. It is important that we manage this dynamic environment where sea and lake levels are gradually rising.

Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in 50 to 100 years, so we have to plan for the future now.

By planning early, there is time to identify future flood risks that may arise and create the best plans to adapt to those risks.

In NSW, councils are responsible for managing local flood risks. In 2012, Council adopted the Lake Macquarie Waterway Flood Risk Management Study and Plan that identifies areas at risk of flooding and tidal inundation. The Plan recommends development of specific local adaptation plans to address flood risks in each low-lying area around the lake.

Project update

Activities to date:

- Community workshop
- Four drop-in information sessions
- Two 'Let's Talk' community information forums
- Online issues and ideas map
- Volunteer Community Working Group formed

Your feedback snapshot enclosed

Snapshot of the planning process

Over the next 12 months, Council will work with the community to...

Phase A

Understand the problem of future flooding and sea level impacts on the coast and current community concerns

Phase B — We are here

Identify possible solutions

Phase C

Determine the most appropriate solutions and prepare a draft Local Adaptation Plan

Phase D

Place the draft Local Adaptation Plan on exhibition, adopt and implement the plan

Get involved!
Visit **shape.lakemac.com.au/adapting-swansea**

Complete the adaptation options survey

What we've heard?

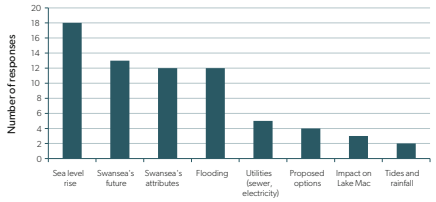
Over the past few months, Council has heard your experiences and concerns about future flood risks in Swansea. From your feedback, we have a greater understanding of the current and future flood risks in the local area and are using this information to inform the planning process. A community engagement summary of the activities undertaken and feedback received is available at **shape.lakemac.com.au/adapting-swansea**.

Council spoke to more than 200 residents and business owners at our face-to-face sessions and received 128 comments and 26 surveys. There have been more than 1000 visits to the Adapting Swansea online project site.

Of the comments received, the most commonly cited issues were maintaining the lakeside lifestyle, managing drainage and sewerage, low-lying land and property inundation, property values, insurance and climate change science.

At the community workshop in August, more than 150 current and emerging issues relating to sea level rise were raised by participants. The significant issues for Swansea identified to be addressed in the short-to-mid-term include foreshore erosion, evacuation and emergency management plan, blocked drains and tidal flooding. Significant issues raised for the mid-to-long-term include access to Swansea Heads and Caves Beach, roads and drainage permanently damaged, and loss of wetlands.

"Why do you think planning for Swansea is important enough for you to volunteer your time at a community workshop?"



WHAT YOU SAID

"Impacts of tides are increasing, imagine one metre more."

"During the last king tide in Swansea, I was shocked by how much water was rising from the stormwater drains and across Bowman Street."

"Swansea is typical of many areas around the lake, but it is also a major thoroughfare to and from the area. If nothing is done there will be serious consequences for many people, we must adapt."

Have your say! Complete the Swansea Community Survey on adaptation options.

Adapting Swansea Community Newsletter 2

Impact	Never	Once a year	2-3 times a year	4-5 times a year	6-9 times a year	10+ times a year
Water over more than 100 metres of the Pacific Highway affecting traffic movements and driving conditions						
Water over the floors of shops and commercial businesses causing short term closure						
Water pooling in foreshore reserves, sporting fields and playgrounds restricting use for a few days at a time						
Water pooling in car parks restricting use for less than 24 hours						
Water pooling in car parks restricting use for at least a few days at a time						

Please provide any additional comments (if you require more space, please attach additional pages).

FOLD LINE 1

TAPE AND RETURN *Please fold, seal and post your completed survey before* **Friday 5 June 2020.** *The reply-paid details are included below.*

Join the conversation

Our community eNewsletters share information about our projects and services, opportunities to shape our future and things to enjoy in Lake Macquarie.

Please select any eNewsletters that interest you and we will add you to the mailing list:

- ☐ Your City Online
- ☐ Lake Macquarie Tourism
- ☐ Museum of Art and Culture (MAC)
- ☐ Creative Lake Mac
- ☐ Lake Macquarie Holiday Parks
- ☐ Community Noticeboard
- ☐ Eco Advocate
- ☐ Landcare update
- ☐ Over 55s
- ☐ Lake Mac Libraries
- ☐ All Abilities Me2 Program
- ☐ Koori Grapevine

FOLD LINE 2, ENCLOSE WITH STICKY TAPE OR KEEP

LAKE MACQUARIE CITY

Delivery Address:
Locked Bag 1906
HUNTER REGION MC NSW 2310

No stamp required if posted in Australia

Planning for Future Flood Risks
Lake Macquarie City Council
Reply Paid 67121
HUNTER REGION MC NSW 2310

What other options will form part of the local adaptation plans as business as usual?

Many of the options to be included in the local adaptation plans will be incorporated into Council's operational plans and delivery program as they are considered to be business as usual. As such, they were not required to proceed to the feasibility assessment, cost benefit analysis and distribution analysis but they are still important options to implement when necessary.

These options fall into the following categories:

- Ongoing community education and engagement
- Flood preparedness and early warning systems
- Policy, regulation and City planning
- Monitoring and maintenance including but not limited to water levels, infrastructure assets, such as bridges, breakwalls and drainage, and environmental assets, such as wetlands
- Access and emergency planning, including evacuation routes
- Sand replenishment and dune management
- Additional foreshore protection works

Related local news

Blacksmiths Surf Amenity Assessment

We're undertaking a surf amenity assessment at the southern end of Blacksmiths Beach. The natural movement of the waves is transporting sand and sediment, and this is changing the behaviour of the surf, including wave size and surfing amenity.

Find out more at **shape.lakemac.com.au/blacksmiths-beach-surf-assessment**

Swansea Tidal Gates

We are excited to announce that Council has been awarded a grant to trial small-scale tidal gates at Swansea to help mitigate inundation risks in the local stormwater system, proudly funded by the NSW Government as part of its Increasing Resilience to Climate Change grant program.

Find out more under project news at **shape.lakemac.com.au/adapting-swansea**

Coastal Management Program

The Coastal Management Program identifies new opportunities to improve the health of our lake, care for our beaches and coastline and manage Swansea Channel and waterways, while maintaining community access and recreation.

Share your ideas and find out more at **shape.lakemac.com.au/coastal**

Pelican Foreshore

In 2019, Council engaged Salients Consulting to develop foreshore stabilisation concepts for 900m of foreshore at Pelican between Naru Point and Little Pelican. Three conceptual design schemes have been developed and are undergoing technical and economic assessment with results expected in July.

Following Council's review, the results and recommendations will be made available for public review.

Marks Point Belmont South Foreshore Management Plan

This Plan focuses on erosion, inundation and public access along the foreshore at Marks Point and Belmont South and considers the impacts of rising lake levels. We are reviewing concept designs for mitigation actions and preparing the draft Plan, which will be available for public review later this year.

Find out more at **shape.lakemac.com.au/adapting-marks-point-belmont-south**

Rehabilitation of Lake Road, Swansea

Rehabilitation works along Lake Road will be delivered over multiple stages. The first stage involves the area of road closest to the lake and connecting with The Esplanade. Concepts for this stage are now under review. The intersection with The Esplanade will be improved to allow for safer pedestrian and vehicle movements. Construction of this stage is expected to start in the 2020-2021 financial year. Later stages of the project will deliver further improvements on Lake Road between The Esplanade and Josephson Street, including road resurfacing and drainage reconfiguration works.

Replacement of Swansea Jetty on Belmont Street

Detailed designs for a new jetty and floating pontoon structure are underway. The concepts for the structure were endorsed by Council's Aquatic Services Committee, with the fixed jetty and floating pontoon combination the preferred option to suit the local conditions and recreational needs. The project is scheduled for construction from September and we are aiming for completion at the end of this year, in time for next summer.

Have your say

Planning for Future Flood Risks

Pelican, Blacksmiths, Swansea and surrounds

LAKE MACQUARIE CITY

Newsletter May 2020

The project

Local adaptation planning assists coastal communities that may be vulnerable to flooding and tidal inundation impacts as sea and lake levels rise. Swansea, Pelican, Blacksmiths and Caves Beach each have future flood and coastal risks unique to these areas. Planning to adapt communities over time to mitigate future flood risks allows local residents and businesses to assess the risks early, tailor adaptation options to meet local needs and act when and where necessary.

We are working together to keep our community safe now and in the future. Decisions we make can have lasting impacts. Many of the new roads, drains and homes built today will likely still be around in 50 to 100 years, so we need to plan for the future now.

COVID-19 response

In response to the evolving situation with COVID-19, Council is continuing to follow all advice provided by Federal and State health authorities, taking measured precautions to ensure we do everything we can to keep our staff and community safe.

A full list of available support and information on services and facilities is available online at **lakemac.com.au/COVID-19.**

We want to keep our City moving and we are continuing to progress project work, such as the local adaptation planning projects, as much as possible under these new and challenging conditions.

We're working to ensure our community stays connected and gets the services it needs.

Where are we now?

Council continues to collaborate with the Community Working groups for the Pelican and Blacksmiths and Swansea and Surrounds Local Adaptation plans, as well as a project steering committee involving community members and NSW Government representatives. Last month, a feasibility assessment of adaptation options was completed by our consultant, Umwelt, as part of the NSW Government's evaluation process.

Over the past two years, residents of Pelican, Blacksmiths, Swansea and surrounding areas submitted more than 150 options aimed at addressing future local flooding and tidal inundation issues. The joint Council and Community Working groups shortlisted 31 adaptation options for the feasibility assessment, eight of these are progressing to the cost benefit analysis (see over the page). Other adaptation options will be applied as part of our regular operations.

The feasibility assessment examined how easily options can be implemented with minimal impacts to the community and environment, and how effective they would be in mitigating or preventing identified future flood risks. Find out more about the Feasibility Assessment Report and other adaptation planning process guides on the Adapting Swansea and Future Pelican Blacksmiths websites.

Snapshot of the planning process

We're continuing to work with the community to...

Phase A

Understand the problem of future flooding and sea level impacts on the coast and current community concerns

Phase B

Identify possible solutions

Phase C *We are here*

Determine the most appropriate solutions and prepare draft Local Adaptation plans

Phase D

Place the draft Local Adaptation plans on exhibition, adopt and implement the plans

02 4921 0333 lakemac.com.au council@lakemac.nsw.gov.au lakemaccity lakemac

Get involved! Visit shape.lakemac.com.au/adapting-swansea and shape.lakemac.com.au/futurepelicanblacksmiths

Complete the tidal inundation survey

Options included in the cost benefit analysis

The following options to be assessed in the cost benefit analysis have been selected in collaboration with the Community Working groups and steering committee. The figures show one suite of staged adaptation options proposed for the Swansea economic centre (CBD) to manage the effects of climate change and sea level rise. For more information visit **shape.lakemac.com.au/adapting-swansea** or **shape.lakemac.com.au/futurepelicanblacksmiths.**

Figure 1: *This image shows the current scenario in Swansea CBD through to Black Neds Bay.*

Figure 2: *This image shows the current scenario when flooding occurs. At present, when water levels in Black Neds Bay rise, water enters the drainage lines and water backlogs in the system due to the flat terrain. The water then pools up on either side of the Pacific Highway, in the CBD area and across to Wood Street.*

Figure 3: *This image represents the future scenario if no action is taken to directly adapt to the issue. The extent and depth of flooding will increase in addition to wave overtopping occurring in Black Neds Bay into the adjacent properties and beyond.*

Figure 4: *This image depicts a series of staged adaptive measures. Stage 1 shows the raised revetment along the western-side of Black Neds Bay as a first protection method against inundation. Stage 2 protects the residential land on the western-side of Black Neds Bay by raising and filling properties. Stage 3 shows the raised Pacific Highway to eliminate inundation impacts on connectivity to the area. Stage 4 shows the final scenario of raising Swansea CBD to prevent inundation by potentially constructing a new CBD on existing car parks.*

Raise and fill land and built assets options

1. **Raise and fill residential areas**
   This option involves raising residential land and assets (houses, roads, drainage and other infrastructure) by filling low-lying areas until they are above the required projected flood planning level.
2. **Raise and fill other areas**
   This option involves raising land and other assets and infrastructure in non-residential areas including educational land and schools, recreational land including foreshore, reserves and playing fields, Swansea Holiday Park, and commercial land in the economic centre (CBD) to ensure they remain serviceable as sea and lake levels rise.

Channel and foreshore protection works

3. **Protection works at Black Neds Bay**
   This option involves installation of a raised revetment, similar to existing breakwalls and other hard protection works, to create a barrier between the ocean and the economic centre (CBD) to protect the area from sea level rise and wave overtopping.
4. **Raise Ungala Road**
   This option involves the infrastructure to raise the road, and act when necessary to protect properties and community assets near the boat ramp and prevent flooding on Mankilli Street and further along Ungala Road towards Grannies Pool.
5. **Relocate holiday park**
   This option involves relocating Swansea Holiday Park to another area locally in the City, protecting environmental assets and maintaining community access to the foreshore for recreational use.

Wetland and environmental assets protection options

6. **Wetlands move onto environmental land**
   This option allows the wetlands to naturally migrate landward onto lakeside environmental protection zoned land as water levels rise in the channel and lake.
7. **Wetlands move onto other types of adjoining land**
   This option allows the wetlands to naturally migrate landward as water levels rise in the channel and lake – this may involve loss of reserves and acquisition of other public or private assets.
8. **Offset losses of wetlands with reservations in lake areas**
   This option compensates the losses of existing wetland areas with the development of protected wetland reserves elsewhere around the lake.

Business as usual 'base case'

The base case involves continuing business as usual, which includes coastal protection works along the channel, infrastructure protection works, regular maintenance, community education and engagement and emergency preparedness and response. However, it does not involve additional adaptation options to address potential impacts of rising sea and lake levels and future flood risks.

Next steps

Cost benefit analysis

The cost benefit analysis of adaptation options is an assessment method that sets the costs and benefits on common ground so that they can be compared and evaluated. The cost benefit analysis is designed to take into account the full range of potential benefits and costs of each option, including measuring them over time. It also evaluates a 'base case' scenario, where we maintain our business as usual delivery of programs across the area.

The framework is focused on the social welfare of local communities and can assist in guarding against bad decisions. Factors influencing the cost benefit analysis include:

- probability of flood event height and speed
- consequences of flood event, such as property damage, injury or loss of life
- capital costs and ongoing operation and maintenance costs of each adaptation option

Distribution analysis

Following the cost benefit analysis, a distribution analysis examines the same options to identify the distribution of costs, benefits and implications for different parties involved, including the NSW Government, Council, property owners, the local community, visitors and businesses. This work will provide an understanding of the financial implications if or when the examined options are required.

Develop the draft Local Adaptation Plan

The development of the draft Pelican and Blacksmiths Local Adaptation Plan and draft Swansea and Surrounds Local Adaptation Plan is the final action of Phase C of both projects. The draft plans are expected to be submitted to Council for review and placed on public exhibition later this year.

Have your say! Help us understand when to act, complete the survey by **5 June.** **Sign up!** Join the project for progress updates.

Planning for Future Flood Risks
COMMUNITY SURVEY

Community acceptance and tolerance levels of tidal inundation

Part of the local adaptation planning process involves determining when particular actions need to be taken. This survey will help establish the community's threshold for potential flooding and tidal inundation impacts by asking how your household would accept the possible changes, such as to your lifestyle and property, access to roads and footpaths to visit shops and services, and outdoor spaces.

This survey can also be completed online at **shape.lakemac.com.au/adapting-swansea** and **shape.lakemac.com.au/futurepelicanblacksmiths.**

Tell us about you

Name _____ Email _____

Where do you live (please tick): ☐ Swansea (north of Lake Rd) ☐ Swansea (south of Lake Rd) ☐ Swansea Heads ☐ Blacksmiths ☐ Pelican Foreshore ☐ Pelican ☐ Black Neds Bay ☐ Caves Beach ☐ other: _____

What is your age (please tick): ☐ Under 20 ☐ 20-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-70 ☐ 70+

Gender (please tick): ☐ male ☐ female ☐ prefer not to say

Are you a (tick all that apply): ☐ Land or property owner ☐ resident ☐ business owner ☐ other: _____

Please share your thoughts on the following statements

How many times a year would you be willing to accept the following tidal inundation impacts:

Impact	Never	Once a year	2-3 times a year	4-5 times a year	6-9 times a year	10+ times a year
Water over small sections of local roads and footpaths restricting use for less than 24 hours						
Water over many local roads and footpaths restricting use for less than 24 hours, with access to the suburb and to individual properties still available						
Water over many local roads and footpaths restricting use for less than 24 hours, and access to the suburb and to individual properties disrupted at intervals						
Water over small sections of local roads and footpaths restricting use for 2-3 days						
Water over many local roads and footpaths restricting use for 2-3 days, with access to the suburb and to individual properties still available						
Water over many local roads and footpaths restricting use for 2-3 days, and access to the suburb and to individual properties disrupted at intervals						
Water over roads and footpaths preventing access to local shops, doctor, friends or club for a few days at a time						
Water over roads and footpaths preventing access to local shops, doctor, friends or club for a few days at a time						
Water pooling in part of my yard for a day or two at a time, but never reaches the floor level of my house, sheds or garage						
Water pooling in part of my yard for a week, but never reaches the floor level of my house, sheds or garage						
Water pooling in my yard for a week or more and rises above the floor level of my garage or shed for less than 24 hours						
Water pooling in my yard for a week or more and reaches the floor level of my house for less than 24 hours						

Community Newsletter May 2020

Appendix 2.5: Community exhibition of draft LAP

Engagement activities

Council exhibited the draft LAP for 42 days, from 2 August 2021 to 12 September 2021.

Key elements of the community working group and Council designed communications and engagement plan include:

- Shape Lake Mac page with online submission form
- Direct emails to 30 external stakeholders including government agencies, community organisations and business/industry groups including the insurance, building and development sector
- Direct emails to the community LAP working group to share with their contacts
- Postcards and posters distributed at local centres
- Corflute posters installed at key locations in LAP suburbs
- Letterbox drops with trifold flyers – please see note below
- Promotional video for social media
- Social media posts on Council's Facebook page
- Media release
- New FM and 2HD community radio announcements
- Inclusion in Shape Lake Mac e-news (4752 subscribers)
- Inclusion in Your City Online e-news (9682 subscribers)
- 96 text messages sent to previous "Let's Talk" participants
- Email campaign to 1638 people who participated in previous engagement for Pelican, Blacksmiths, Swansea. 61% opened the email and 46% visited the website (sent 3 August)
  - A follow up email was sent to this email list in mid-August informing recipients of online sessions (57% open rate, 23% visited the website)
  - A final email was sent on 5 September promoting the final online sessions and advising close date for submissions (51% open rate, 21% visited the website)
- Promotion in the Eco Advocate e-news - (6638 subscribers sent 19 August - 33% opened)

Council was advised that at least 25 residents living in the LAP suburbs had not received the tri-fold brochure in the mail. Following enquiries with Australia Post, Council staff in collaboration with LAP working group members distributed additional postcards and flyers in the area, including to those people that had missed the letterbox drop.

Online information sessions and further engagement activities

As a result of Covid-19 public health orders, Council needed to cancel the five community drop-in sessions that were originally scheduled for the exhibition period, replacing them with six online information sessions and an offer to meet one on one to discuss the draft LAP.

Online information sessions were set up as Facebook events and promoted as paid posts. Overall, the number of people reached was 34,177 with 85 responses to the event listing (people indicating their interest in attending). Additional promotion was conducted by Shape Lake Mac e-news email (4752 subscribers) and updates to the project's Shape Lake Mac site.

The one-hour online information sessions were held at 1pm and 5pm on Thursday 26 August, Monday 30 August and Tuesday 7 September.

Each session included:

- information on how to access an online and/or hard copy of the draft LAP
- an overview of the draft LAP, including rationale, objective and actions
- information on how to make a submission
- time for questions and discussion.

In summary, 23 community members, five working group members, one Councillor and three Council staff attended the online information sessions.

Online information sessions and further engagement activities

- The Shape Lake Mac website for the draft LAP received 868 total visits
- Volume one of the draft LAP received 67 downloads
- Volume two of the draft LAP received 33 downloads
- The "flipbook" for Volume One of the draft LAP received 2066 opens. 482 people read/engaged with the document with an average reading time of six minutes 47 seconds
- The "flipbook" for Volume two of the draft LAP received 1987 opens. 214 people read/engaged with the document, with an average access/reading time of five minutes and nine seconds.
- Council staff also provided hard copies of LAP volumes one and two to 15 working group members and five community members.
- As a result of the 30 direct emails sent to external stakeholders, Council received positive feedback on the draft LAP from representatives of NSW DPIE, Hunter Water and the University of Newcastle.

Submissions

Council received 16 formal submissions on the draft LAP including 15 submissions from City residents and one from a developer. This compares favourably with the total of six submissions received by Council in 2015 as a result of the 60-day exhibition for the draft Marks Point Belmont South LAP.

Key issues and themes raised in submissions included:

- twelve of the 16 submissions received expressed either support (four) or strong support (eight) for the draft LAP, three submissions were neutral and one strongly opposed the draft
- respondents supporting the draft LAP raised timely action around on-ground works (three), preventing flooding and protecting wellbeing (five), the need for immediate and ongoing funding (five) and the need for flexible/adaptable trigger-based implementation of the LAP (three)

- four submissions flagged the need for action related to sewerage and drainage infrastructure whilst four raised the importance of inter-government/agency collaboration
- of the five submissions that included reference to funding and governance – three respondents flagged the importance of – or interest in - the cost benefit analysis, including concepts of beneficiary pays and the need for future capital reserves to address climate change
- of the three neutral responses received two were generally positive in nature, with one of these indicating an interest in participating in future working group activities
- one submission strongly opposed the draft LAP based comments and questions related to the causes of flooding and coastal erosion not relating to sea level rise
- four submissions expressed appreciation of current and former LAP working group members, Council and council staff for support
- nine respondents indicated an interest in participating in future LAP working group meetings/activities whilst five wished to be kept informed.

As a result of submissions and feedback received during the exhibition Council made around 30 minor amendments to the draft LAP (Volumes 1 and 2) to correct or clarify wording. No substantive changes to the draft LAP findings, actions or implementation plan were recommended as a result of the exhibition.

APPENDIX 3

Hazard summaries for LAP areas

3.1 Pelican and Blacksmiths hazard summaries

	Hazard	Community ideas
BEACH SIDE	**Beach erosion** - The natural process of sand removal from beaches during storms when large waves, elevated water levels and strong winds occur. During rare storm events significant quantities of sand can be moved offshore undermining buildings, roads and other infrastructure. Beach access can become hazardous to the public. Eroded sand is generally returned to the shore naturally and the beach gradually rebuilt over several years. 	Build up dunes with additional sand Construct and maintain seawalls along the beach Construct an artificial offshore reef Restrict 4WD access to the beach to strengthen dunes Strengthen dunes with native vegetation Community monitoring of erosion trends
	Beach recession - The slow landward movement of the shoreline over the long term. It occurs when the supply of sand to the beach is less than the amount of sand being lost, and is intensified by rising sea levels. As the shoreline moves landward it will bring coastal hazards closer to property, potentially increasing risk. 	
	Coastal inundation - can occur during high tides combined with storms, when sea water from waves overtops coastal barriers such as dunes and seawalls, and inundates areas behind the beach and dunes. This type of inundation can also be caused by coastal creeks, estuaries and stormwater systems that are connected to the ocean when ocean levels are high. Elevated sea levels as a result of sea level rise contribute to coastal inundation. 	
CHANNEL	**Channel evolution** - Since the late 1800s, Swansea Channel has continued to adjust itself in response to ongoing engineering works that allow the channel to be navigable. The channel 'training wall' attempts to protect against movement of the entrance—channel evolution. This rock armoury influences the shape of the channel, velocity of water movement and erosion both upstream and downstream of the Swansea bridge. 	Monitor impact of channel dredging on foreshore Community monitoring of erosion trends Construct and maintain seawalls along the channel Move Pelican boat ramp landward Limit development along the channel Set new development back from the channel
LAKE SIDE	**Lake flooding** - The temporary covering of low-lying areas with lake water due to high rainfall across the lake catchment. As the average 'still-water' level of the lake rises with sea level rise, flood levels also rise, so flood waters will be deeper or affect more properties. 	Design buildings that can be adapted to higher flood levels over time Limit housing density in flood prone areas Community monitoring of water level trends Use rainwater tanks to capture stormwater run-off Utilise elevated swales as opposed to pit and pipe drains Improve design of sewer system to prevent failure in floods Produce flood emergency and education plan in conjunction with SES Manage housing density in flood prone areas Build flood detention basins
	Tidal/permanent inundation - The permanent or daily covering of low-lying areas around the lake foreshore with water. As sea and lake levels gradually rise this will worsen. 	Set new development back from the foreshore Raise roads and drains over time Limit new development on areas set to be permanently inundated Allow wetlands to move landward as lake levels rise Ensure new development can be adapted over time
	Lake foreshore erosion - The loss of lake foreshore land from wave erosion. 	Monitor impact of channel dredging on lake foreshore Community monitoring of erosion trends Strengthen lake foreshore beach with seawalls and sand Construct and maintain seawalls along the lake foreshore

Have your say

Planning for future flood and coastal risks

Pelican and Blacksmiths

Information on sea and lake level rise

Living by the coast and lake is a great lifestyle. Managing the coastline and adapting to changing sea and lake levels is important. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in fifty to one hundred years, so we have to plan for the future, now.

Lake Macquarie City Council is committed to providing a safe community now, and in the future. This information sheet provides an overview of sea level rise and how it may affect Lake Macquarie.

Sea levels are rising due to the warming of the atmosphere and oceans, which causes the water in the oceans to expand. In addition, the melting of land-based glaciers and ice sheets increase the amount of water in the ocean.

Sea levels are rising gradually at a rate of around 2.6mm per year in the lake and off the coast of NSW.

The rate of sea level rise is expected to increase over time, resulting in a 0.9 metre increase in sea levels by 2100.

This means low-lying land around the lake could be permanently inundated by 2100. Most of this land is managed by Council, however some of this land includes private property. In addition, approximately 7,500 homes may be temporarily affected if a serious flood were to occur on top of a 0.9 metre rise in lake levels.

Projections and policy

The Lake Macquarie Waterway Flood Risk Management Study and Coastal Zone Hazards and Risk Assessment applied the best advice from international, national and state scientific organisations that sea levels on the east coast of Australia will rise by 0.90 metres by about 2100.

Since these studies were completed the Intergovernmental Panel on Climate Change (IPCC), Bureau of Meteorology and CSIRO have completed a new assessment, including projected ice melt in their modelling. The recommended planning levels for sea level rise on the NSW coast are 0.31 metres by 2050 and 1.02 metres by 2100 relative to the 2015 average levels.

Council reviewed the new levels in 2015 and resolved to continue using 0.9 metres, as it is reasonably close to the most recent reports and changing the planning levels too often would be unhelpful for owners, builders, developers and planners. Planning levels will be reviewed again when there is new scientific advice, or there is a change in government policy.

What causes sea level rise?

Sea levels are rising due to the warming of the atmosphere and oceans, which causes the water in the oceans to expand. In addition, the melting of land-based glaciers and ice sheets increase the volume of water in the ocean.

What can we do?

We can work together to identify local solutions to changing conditions in low-lying areas around the lake.

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Box 1906 HRMC NSW 2310 126-138 Main Road, Speers Point NSW 2284

More info over the page

Am I affected?

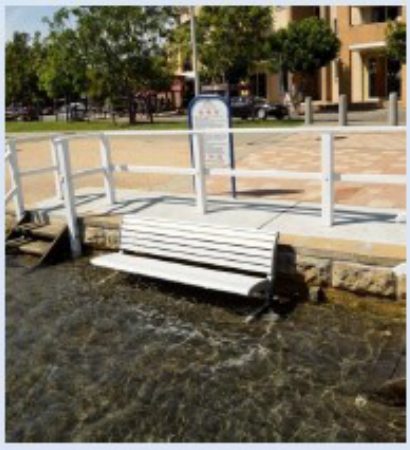
Council is working with the communities of low-lying areas to develop Local Adaptation Plans to manage future flooding and inundation as a result of sea level rise. Local Adaptation Plans guide:

- future land use decisions
- how we design and maintain roads and drains
- what is required to make buildings safe and durable
- emergency response during floods and storm events
- how we manage erosion, beach recession and inundation
- how we keep the lake clean and healthy

The first Local Adaptation Plan was prepared with the communities of Marks Point and Belmont South and can be viewed on Council's website.

Not flood prone land is affected by sea level rise. To find out more about whether your property is in a flood prone area, visit www.lakemac.com.au/development/flooding.

For details on upcoming community events as part of local adaptation planning and fore more information on sea level rise, flooding and drainage, visit: haveyoursaylakemac.com.au/futurepelicanblacksmiths



Other information sheets

- Groundwater and drainage
- Flooding
- Coastal processes and hazards

How is flooding affected by sea and lake level rise?

As sea and lake levels rise, some low-lying areas along the coast and around the lake foreshore may be permanently inundated. This means they are permanently covered by water or regularly covered by tides.

Flooding is different from inundation in that flood waters have a temporary impact, where flood waters cover areas for a period of time in response to an event (most commonly a storm), then they recede.

As the average 'still-water' level of the lake rises with sea level rise, flood levels also rise, so flood waters will be deeper or extend further.

See the Flooding info sheet for more information.

How will sea level rise affect the coast?

Sea level rise is expected to have an impact on shoreline recession at Lake Macquarie beaches. Recession is expected to be greater at the southern end of beaches by the year 2100, however the risk of impact to existing communities is minor.

The extent of recession will vary from beach to beach but as general rule the extent of recession by the year 2050 and year 2100 varies around 20m and 40m respectively. Sea level rise is also expected to intensify coastal erosion and inundation impacts during storm events.

See the Coastal Processes and Hazards info sheet for more information.

Who measures sea level rise locally?

There are three water level gauges in Lake Macquarie operated by the NSW Government, at Swansea, Belmont and Marmong Point.

The gauges measure water levels relative to a fixed point on the land. Relative levels can change due to various factors such as land subsidence or El-Niño cycles and other oceanic cycles that occur at time intervals of 20 – 30 years, as well as sea level rise.

Measurements of relative lake level from the Belmont gauge indicate a rise of 2.6mm a year over the last 25 years, a 6.5 centimetre rise since 1986. The nearest fully calibrated gauge, at Port Kembla and operated by the Australian Bureau of Meteorology, shows a rise of 2.6mm a year since it began measurements in 1991.

Visit Manly Hydraulics laboratory for more information: http://new.mhl.nsw.gov.au

Why plan for sea level rise?

The NSW Government requires all Councils to include the effects of climate change and sea level rise in their planning for flood and coastal risks. Council is responsible for flood planning in Lake Macquarie City. This includes planning to reduce risks to natural and built environments.

Council has a duty of care to ensure assets such as new houses or roads, and the communities that use them, are safe for the life of the asset – this could be up to 100 years. Council's main planning instruments, the Lake Macquarie Local Environment Plan (LEP) and Development Control Plan (DCP), include planning controls to manage the risks from future flooding and sea level rise.

These controls will be reviewed as local adaptation plans are prepared for low-lying areas around the City.

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Have your say

Planning for future flood and coastal risks

Pelican and Blacksmiths

Information on groundwater and drainage

Living by the coast and lake is a great lifestyle, and it is important that we manage this dynamic environment where sea and lake levels are gradually rising. Decisions we make now can have lasting impacts. New roads, drains and homes built today will still be around in fifty to one hundred years, so we have to plan for the future, now.

Lake Macquarie City Council is committed to providing a safe community now, and in the future. This information sheet provides an overview of groundwater and drainage and how they may be affected by lake flooding and rising lake levels.

Low-lying, flat areas around the lake are difficult to drain. Most natural waterways and constructed drains eventually discharge into the lake.

During high tides and lake floods, lake water backs up into low-lying stormwater drains. In some cases, this lake water overflows onto streets and footpaths. Any rainfall is unable to drain away. High groundwater levels can slow or prevent drainage in low-lying areas.

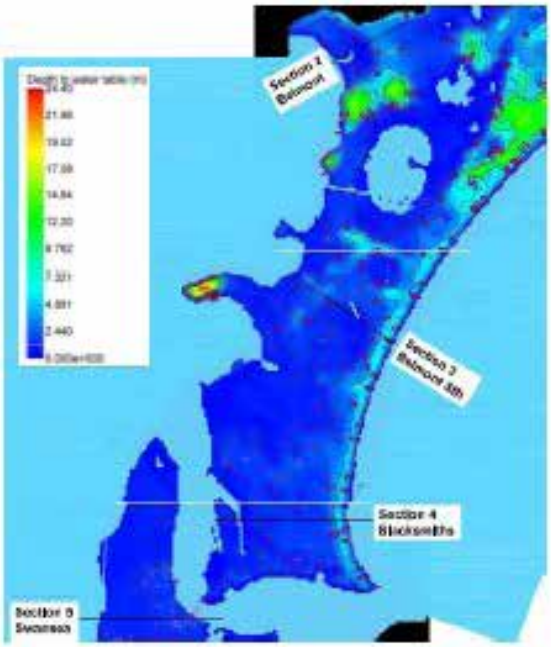

Image source: Report on Groundwater Modelling – Redhead to Swansea

Groundwater is found in 'open' soils such as sand and gravels. Groundwater is fed when rainfall and water from creeks seeps into the ground.

Sea levels are rising gradually at a rate of around 2.6mm per year in the lake and off the coast of NSW. The rate of sea level rise is expected to accelerate over time, resulting in a 0.9 metre increase in sea and lake levels by 2100.

As lake and ocean levels rise, groundwater rises by a similar amount, affecting drainage and other infrastructure such as sewers, road-base and building foundations.

High groundwater levels affect drainage by reducing the ability of rainfall to seep away through the soil, causing pooling on the surface. In low-lying areas, groundwater is generally less than 1 metre below the land surface. This means surface drainage (grass swales) is preferable to pits and pipes below the ground.

Drainage maintenance fast facts

In 2014/15, Council responded to around 1,500 drainage-related service requests, of which around 2% came from the Pelican and Blacksmiths areas.

City drainage budget for 2015/16 financial year:
Excludes work funded by the private sector and Sustainability grants.

Maintenance and asset replacement
Over $2 million

Stormwater Quality Improvement Devices
Around $1.3 million.

New drainage infrastructure
Around $2.1 million

What can we do?

We can work together to identify local solutions to changing conditions in low-lying areas around the lake and coast.

02 4921 0333 www.lakemac.com.au council@lakemac.nsw.gov.au lakemaccity lakemac
Box 1906 HRMC NSW 2310 126-138 Main Road, Speers Point NSW 2284

More info over the page

Am I affected?

Council is working with the communities of low-lying areas to develop Local Adaptation Plans to manage future flooding and inundation as a result of sea level rise. Local Adaptation Plans guide:

- future land use decisions
- how we design and maintain roads and drains
- what is required to make buildings safe and durable
- emergency response during floods and storm events
- how we manage erosion, beach recession and inundation
- how we keep the lake clean and healthy

How can I help?

For details on upcoming community events as part of local adaptation planning and fore more information on drainage, visit:
http://haveyoursaylakemac.com.au/futurepelicanblacksmiths

If you think there is an issue with drainage in your area, submit a service request to Council. Be sure to provide relevant details including location and a description of the issue. Photos can help.

Council responds to over thirty thousand service requests each year, which are prioritised according to available resources, urgency and future scheduled works. It is not uncommon for flat, low-lying areas to have problems with drainage (see over the page).

It is often the case these issues can only be addressed as part of a bigger plan on how to respond to ongoing changes, which local adaptation planning can address.

To submit a service request, call or email Council at the phone and email address at the bottom of this information sheet.

Other information sheets

- Sea and lake level rise
- Flooding
- Coastal processes and hazards

What happens to drains during floods?

In the Lake Macquarie Council area, most natural waterways and constructed drains eventually discharge to the lake. If the water level in the lake rises, it will back-up into pipes and open channels, sometimes overflowing out of grates and pits onto streets and footpaths in low lying areas. Rainfall cannot escape to the lake through the flooded drains, adding to local flooding.

See the Flooding info sheet for more information.

What are the standards for constructed drainage?

Open and piped stormwater drains are generally designed to carry water up to a 1 in 10 year rainstorm (a heavy rainstorm that you might expect to experience, on average, once every 10 years). This provides a system that deals with most rainstorms, at the most reasonable cost to ratepayers. If drains overflow in larger storms, the systems are designed to direct water to overland flow-paths, usually natural watercourses or road gutters.

To function well, drainage systems should have a fall of 1:100 or greater. This ensures water can flow freely and rapidly enough to 'self clean' by removing sediment, leaves and rubbish that washes into the pipes. Sufficient fall can be difficult to achieve in flat areas.

The fall along Goomera Street Blacksmiths, from the roundabout at the shops to the drainage outlet at Pelican inlet, is about 1.5 metres over 1000 metres – a fall of 1:660. Buried drains are at least 300mm underground, typically with a 375mm pipe. This makes it even more difficult to achieve sufficient fall to drain flat, low-lying areas.

Are there any innovative solutions?

Council is trialling new technologies and techniques to improve drainage design and function in low-lying areas. Tidal valves are being installed at Marks Point to test their effectiveness in preventing high lake levels inundating low-lying roads and land. The trial will be monitored by local residents.

New surveying and computer-modelling techniques are being used to assess the design and effectiveness of the drainage system at Marks Point and Belmont South. This should help pin-point problems in the system, and understand the cause of the problem. It should also allow design changes such as filling land or increasing pipe capacities to be tested before they are constructed. If these techniques prove successful, they will be used in other low-lying areas, including Pelican and Blacksmiths.

As lake levels rise, Council will need to raise and re-design stormwater drainage. The Marks Point and Belmont South Local Adaptation Plan commits Council to work with engineering experts over the next few years to develop methods and innovative designs to allow Council to maintain and improve drainage in conjunction with rising lake and groundwater levels.

See the Marks Point and Belmont South Local Adaptation Plan for more information.

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3.2 Swansea and surrounds Hazard Summary sheets

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

TIDAL INUNDATION

What is it?

Tidal inundation is the process in which seawater is driven up stormwater drainage outlets, or over land, that is normally dry ground. Tidal inundation events occur due to a number of factors including king tides, low-pressure cells, poor natural drainage, low-lying areas and rising sea levels.

Large rainfall events and storm surges also impact drainage systems and can lead to worsened tidal inundation events and localised flooding. Climate change and rising sea levels are predicted to further increase the extent and duration of tidal inundation events.

Why is it a problem?

Tidal inundation can restrict access and cause damage to private and commercial property, major infrastructure and roads, drainage, motorists and pedestrians. Tidal inundation also affects the natural environment with important ecosystems and areas of high biodiversity experiencing salt-water inundation. Extreme tidal inundation events have the potential to cut off major roads and inundate parked cars and properties.

As sea levels rise, the frequency of tidal inundation events and the severity of impacts in Swansea and the surrounding areas will increase.

When will it happen?

Currently, tidal inundation events occur in Swansea around fives times a year. Without adapting the area's infrastructure, the number of inundation events is likely to double with 0.1m sea level rise.

To date, tidal inundation is a short-lived hazard, lasting four to six hours over parts of Swansea, although some areas have water pooling for a day or two after a king tide event.

If we don't adapt, it is predicted that by around 2045, the Pacific Highway at Swansea will be inundated by king tides several times a year.

Map of Swansea showing extent of 1.1m tidal inundation for a current day event from 2D modelling (Generated by WMA Water using TUFLOW in 2019).

Where will it occur?

Tidal inundation will occur along Swansea Channel peninsula and the surrounding areas, including Black Neds Bay. Low-lying areas will be at greater risk of tidal inundation (refer to map above).

Tidal Inundation Hazard Summary

PLANNING FOR FUTURE FLOOD RISKS
FACT SHEET

LAKE FLOODING

What causes lake flooding?

Lake flooding can be caused by heavy rainfall on and around the lake and its catchment and can be influenced by off-shore conditions and other meteorological anomalies. Cockle Creek and Dora Creek catchments are the largest contributors to run-off into the lake. The level of flooding is affected by the amount of rainfall on and around the lake and the ocean conditions at the entrance to Swansea Channel.

If there is a high tide or a storm surge at the ocean entrance while there is rainfall over the lake catchment, the lake flood level will be higher.

Why is it a problem?

Lake flooding can cause damage to property, such as houses and vehicles, and public assets including roads, drainage systems, ovals, telecommunications, power and sewer. Flooding can also endanger people through drowning, injury and health risks.

When will it happen?

Currently, minor flooding (nuisance) events occur regularly in Swansea, affecting roads, car parks, reserves and drainage. Major flooding (significant) events occur approximately every 10 years (e.g. 2007, 2015). The frequency and extent of flooding are projected to increase with changing climate conditions.

To date, lake flooding for major events lasts approximately two days, peaking approximately 10 hours after the rainfall. The duration is dependent on the intensity and frequency of rain events and ground saturation.

With projected climate change and sea level rise, the frequency, duration and impacts of significant events are predicted to increase, as shown in the figure overleaf by the increasing number of floor levels impacted from now until 2100.

Map of Swansea showing 10% AEP flooding extent (similar to the Pasha Bulker Storm, 2007) from TUFLOW modelling undertaken by WMA Water in 2019

Where will it occur?

Lake flooding will occur particularly along the Swansea lake shoreline, around the headland and through to the channel. Low-lying areas will be at greater risk of lake flooding (refer to map).

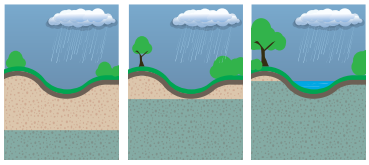
Lake Flooding Hazard Summary

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

GROUNDWATER

What is groundwater?

Groundwater is found in 'open' soils, particularly sand and gravel above a layer of rock or clay, that prevents or slows water from draining away. Groundwater occurs when rainfall and water from creeks seep into the ground. Groundwater is also known as the ground water table, the level at which water exists under the ground.



Groundwater changes in low-lying areas over time in accordance with sea levels.

Why is it a problem?

During prolonged wet spells and as sea levels rise, groundwater levels will increase. High groundwater levels affect drainage by reducing the ability of rainfall to seep away through the soil, causing pooling on the surface that can remain for days after heavy rain. Drains installed at or below the level of the groundwater will be ineffective.

If groundwater is at seasonally high levels it will discharge into creeks, drainage channels and wetlands, reducing their capacity to contain and carry run-off.

Groundwater, particularly saline groundwater, can also affect other in-ground infrastructure such as sewers, road-base and building foundations. The effects of rising groundwater on infrastructure will be investigated in more detail in community local adaptation plans.

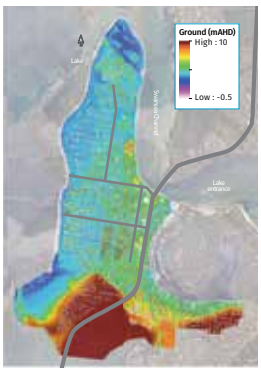
An independent study by groundwater experts shows that as lake and ocean levels rise, groundwater between Belmont South and Swansea will rise by a similar amount.

When will it happen?

Monitoring by the NSW Government shows that lake levels are rising at a rate of around 2.6mm per year. The rate of sea level rise is predicted to accelerate over time, resulting in a 0.9m increase in sea and lake levels by 2100.

Where will it occur?

The sandy soils between Redhead and Swansea contain a freshwater aquifer (pool of groundwater) that fills with run-off water from the Jewells catchment, as well as local rainfall. The level of the groundwater is controlled by the level of the lake and the ocean, although it will vary a little depending on rainfall. The groundwater level is generally only 0.5 to one metre below the land surface in flat areas. Those areas that are lowest lying will be the first impacted by groundwater.



Digital terrain model by WMA Water 2019

Groundwater Hazard Summary

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

CHANNEL DYNAMICS

Channel dynamics cause erosion along the foreshore. The Swansea Channel Hazard Study and Risk Assessment highlights channel dynamics as an ongoing risk.

Swansea Wharf closure demonstrates the damage caused to assets by channel dynamics.

What is it?

Channel dynamics refers to the changing behaviour and movement of Swansea Channel, the ocean entrance to Lake Macquarie. The ocean entrance (downstream end) of the channel is controlled and permanently open due to the constructed breakwater (wall) at Blacksmiths Beach and Swansea Heads. As the channel is artificially held open, it will continue to evolve until it reaches a steady state, which is typically achieved by widening and meandering. However, as rockwalls control the channel it cannot widen and meander easily, this results in the following changes:

- Velocity of channel flows
- Depth and width of the channel
- Navigable route
- Increased foreshore erosion.

Why is it a problem?

Channel dynamics can influence access and cause damage to private and commercial property, infrastructure such as seawalls, revetments, roads, drainage, utilities, public reserves and threaten the safety of foreshore users and swimmers.

The dimensions of the channel also directly control the exchange of tidewater between the ocean and the lake. Any change in this control will likely have major impacts on the entire lake and surrounds.

Long-term solutions to channel dynamics are incredibly expensive, requiring multiple stakeholders to chip in for the cost. Council has recently implemented a short-term solution at Pelican foreshore, which was designed to last one summer season. This solution can be seen in the photos overleaf.

As sea levels rise, the frequency and extent of damage occurring will increase, resulting in significantly more impacts on suburbs around the channel and also low lying suburbs around the lake.

When will it happen?

The impacts of channel dynamics are being felt now, with some existing near-shore infrastructure being undermined and subsequently collapsing or being at risk of collapse.

If we do not adapt to this changing hazard then it is expected that the damages and risk will increase, potentially posing a threat to public and private assets and public safety.

Where will it occur?

The changes related to channel dynamics will be felt along the entirety of the Swansea Channel. Those areas closest to the channel will be at greater risk of encountering this hazard.

Channel Dynamics Hazard Summary

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

EAST COAST LOWS AND STORM SURGE

What is it?

East coast lows (ECLs) are intense low-pressure systems that occur off the east coast of Australia. These storms can bring damaging winds, heavy rainfall and huge surf. They can cause coastal erosion and flooding as a result of elevated sea and lake water levels.

While ECLs can cause hazardous and costly storms, they are also important for water security, bringing the heavy soaking rainfall that fills dams along the coast and the tablelands.

CoastAdapt NSW reports that ECLs produce nearly a quarter of all rainfall along the coast and are responsible for around 40 per cent of the heavy coastal storms we see.

While ECLs can often result in elevated sea and lake levels, storm surge can be caused by a number of other factors including coastal trapped waves and other meteorological anomalies.

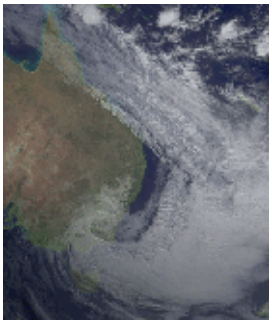
Why is it a problem?

Storm surge occurs during extreme storm conditions when strong onshore winds and low atmospheric pressure combine to bring about a temporary and localised increase in sea level. With an estuary like Lake Macquarie, storm surge water levels might be affected by a range of physical processes. Apart from wind and atmospheric pressure changes; ocean and local wind generated waves and catchment runoff can contribute to elevated water levels causing flooding and increased tidal inundation.

Large rainfall events and storm surges also apply pressure to drainage systems that lead to worsened tidal inundation events and localised flooding. Climate change and rising sea levels are predicted to further increase the extent and duration of tidal inundation events.

ECLs have a significant impact on coastal dunes by increasing coastal erosion and dune recession, potentially leading to damage of natural and built assets.

ECLs can also cause flooding in low-lying areas frequently leading to damage of private and public assets.



Satellite image: 8:30am 27 June 2007 - originally processed by the Bureau of Meteorology from the geostationary meteorological satellite MTSAT-1R operated by the Japan Meteorological Agency

When will it happen?

Storm surge and ECLs can form at any time of the year and significant ECLs occur on average about 10 times each year. Recent ECLs that have caused damage in Lake Macquarie and its coastline occured in 2007 (the Pasha Bulker storm), 2015 and 2016.

Storm surge and associated inundation of low-lying coastal lands are expected to increase due to climate change (CSIRO, 2007).

Where will it occur?

Storm surge and associated increases in wave height, tidal inundation and flooding will predominantly impact on our coastline and the low-lying areas of the entrance channel and the lake. These areas include Swansea Heads, Swansea, Caves Beach, Pelican and Blacksmiths.

East Coast Lows and Storm Surge Hazard Summary

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

COASTAL HAZARDS

The June 2016 east coast low caused significant damage along the Lake Macquarie coastline.

Damage to assets at Blacksmiths Beach.

What is it?

The coastal hazards experienced on the Lake Macquarie coastline are extreme storm events, storm surges and human activities, which have significant negative impacts including beach erosion, shoreline recession, wave overtopping, coastal inundation, entrance channel instability, sand drift and dune slope instability. Coastal hazard impacts most commonly occur at beaches, where the coastline is more vulnerable. These areas are also known as 'action zones'.

Specific coastal hazards applying to Swansea, Swansea Heads and Caves Beach include coastal erosion, inundation, wave overtopping, cliff stability and sand movement (erosion and accretion).

Why is it a problem?

Residents and visitors enjoy Lake Macquarie beaches and coastline, the natural environment and built facilities/amenities, such as surf clubs, parks and playgrounds. Many also enjoy living near the coast. This interaction between people and the coastal landscape has many social and economic benefits but can lead to threats to our built assets and natural systems. These threats are predicted to increase with further development along the coast, coinciding with projected sea level rise and increased intensity and frequency of storm events.

When will it happen?

The coastal environment is constantly changing. Coastal processes operate at different time scales, varying from hourly/daily to decades or more. Some processes vary in predictable ways, while for others the extent and rate of change are much less certain. There is significant uncertainty associated with exactly how and when coastal change will occur in response to coastal processes.

The Lake Macquarie Coastal Zone Management Plan 2015 identified coastal hazard lines, which show the coastal areas at risk now, in 2050, 2100 and 2100 (critical and essential infrastructure). See below.

PLANNING FOR FUTURE FLOOD RISKS
SWANSEA HAZARD SUMMARY

EMERGENCY PLANNING AND RESPONSE

What does emergency response involve?

An emergency is defined as an actual or imminent occurrence of events such as fire, flood, storm, tsunami, earthquake, etc. that endangers the safety or health of people or animals, or destroys or damages property requiring a significant and coordinated response.

Emergency planning and response is the coordinated approach to help a community safely through a natural disaster or other emergency. This includes planning and coordination of services for the Lake Macquarie area, public education and awareness of how to plan for emergencies and evacuation.

Why is it important for managing future flood risks?

A community's response to flood hazards, especially during a flood event, can have a significant impact on safety for residents and visitors in the area. Education and awareness about flood hazards, how to prepare your family and property during an emergency, evacuation routes, early warning systems, and how to connect with broadcast information and emergency services, are some of the ways emergency response can help keep communities safe.

As sea and lake levels rise, the predicted risk and frequency of flooding increases. Planning for a community's response to future flood risks is part of the Local Adaptation Plan for Swansea and Surrounds.

What services and plans will activate during an emergency?

The NSW SES Lake Macquarie City Flood Emergency Sub-Plan covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding in Lake Macquarie. During floods, evacuations are controlled by the NSW State Emergency Service (SES).

The SES protects and preserves life and property during an emergency. Additional emergency services, including NSW Police, Fire and Rescue, and NSW Ambulance, will also respond and work together with the SES to help and protect the community.

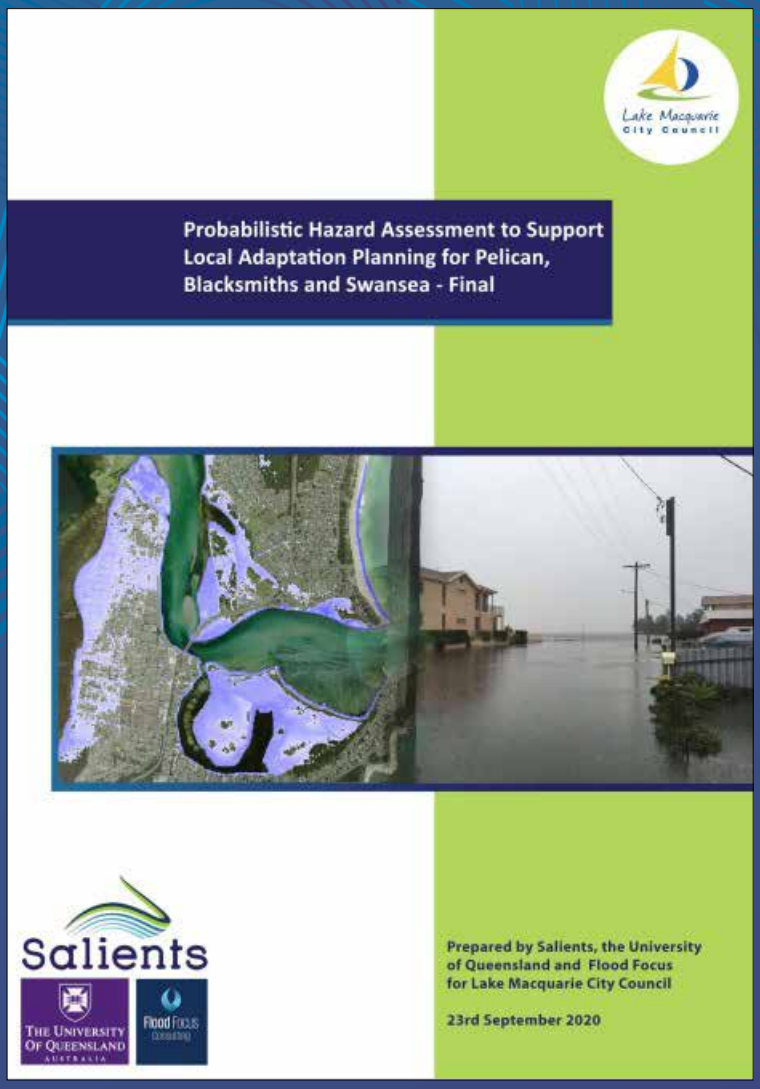
The Early Warning Network (EWN) is a location-based warning system for severe weather and incident alerts

Swansea evacuation routes, developed as part of a Swansea Flood Study (Umwelt 2016)

Emergency Planning and Response

APPENDIX 4

Summary of Probabilistic Hazards and Damages Assessment



Salients

Executive Summary

Risk Management and the Need for Probabilistic Hazard Assessment

The traditional approach to engineering and planning involves setting a standard for design. An example of this is the "1 in 100-year flood", the flood that has a 1% chance of occurring in any given year, also known as the 1% AEP (Annual Exceedance Probability) flood. This flood is often adopted in New South Wales as the standard for determining building floor heights.

The adoption of this standard is an example of risk management, where a 1% chance, in any given year, of above floor damage has been judged to be tolerable. Risk management is a way of dealing with uncertainty.

While it may not be as immediately apparent, similar risk management decisions are made in developing standards to guide the design of structures such as high-rise buildings and bridges, making sure that they are strong enough to not fall. In that case the strength of materials used in construction (concrete, steel, timber etc.) are also subject to some uncertainty, as are the environmental conditions that they might experience in their lifetime which could contribute to weakening of those materials and possible failure. All these matters are considered in the development of engineering standards to ensure that the likelihood of structures failing during their designed lifetime is tolerably remote.

The approach of writing formal standards (such as those published by Standards Australia or Engineers Australia) is appropriate where the uncertainties are well understood. However, in the case of hazards associated with waves, storms, tides and floods in highly dynamic coastal environments, the effects of different processes and their interactions are subject to significant uncertainty and sometimes the processes themselves are not well understood.

A typical engineering approach is to play it safe in this scenario. Where there is significant uncertainty associated with many contributing processes, a common approach would be to combine the effects of a severe occurrence of each process. For illustration, a 1% AEP ocean storm could be combined with a 1% AEP catchment flood. The interaction of two processes would be simulated using computer models to determine the appropriate flood planning level. However, the chance that a 1% AEP ocean storm will occur at the same time as a 1% AEP catchment flood is extremely remote. In some areas this approach will result in a flood planning level that greatly exceeds the 1% level that would be adopted with a more rigorous approach. This approach of combining extremely rare events is recognised as being "conservative", meaning that it errs on the safe side, to avoid harm to people and property. A key concern of engineers is to make sure that people and property are kept appropriately safe and, in the face of significant uncertainty, a conservative stance is often adopted.

Due to the uncertainty associated with many coastal processes, the conservative approach is very common in Coastal Engineering. An example of this is the combination of the processes contributing to beach erosion. In NSW, it has been common to add the effects of extreme erosion to a conservative assessment of long-term trends in beach adjustment alongside

Full report: https://shape.lakemac.com.au/37415/widgets/210625/documents/195932

enhanced future beach recession due to a relatively high projection of sea level rise. These assumptions are then used to derive coastal erosion hazard lines which guide where beach front residences can be located with a tolerable level of safety.

Alongside the need to deal with significant uncertainty, Lake Macquarie City Council is presently working with communities in suburbs that are likely to be adversely affected by future sea level rise at some time in the future. In some cases, the early effects of sea level rise are already being experienced. Through a process of deliberative governance, the community is being encouraged to participate in the decision making leading to the development of Local Adaptation Plans for various localities around Lake Macquarie. As part of this process, the community is required to consider the two key components of risk:

- Likelihood that events of different magnitudes will be encountered.
- Consequences of those events occurring.

With these matters in mind, decisions will need to be made as to whether different risks are tolerable or not. If risks are intolerable, then actions will be required to gradually adapt settlements such as Pelican, Blacksmiths and Swansea.

Recent coastal management reforms in NSW have also resulted in the production of guidance that encourages "probabilistic hazard assessment". This type of assessment aims to attach probabilities to events of different magnitudes. In other words, we aim to say that there is a "*70% chance that this water level will be exceeded*" instead of saying *"it is likely that the water level will be exceeded"*. The state government particularly encourages probabilistic hazard assessment where significant expenditure could be required to fund adaptation options.

Inundation Hazards within The Study Site

The study presented in this document deals with "inundation hazards" within Pelican, Blacksmiths and Swansea, the main settlements along the foreshores of Swansea Channel (Figure E.1). There are two sources of inundating water:

- Ocean: Combined effects of tides, storm surge, mean sea level and other oceanic effects.
- Catchment: Heavy rainfall on the catchment and runoff filling Lake Macquarie.

Respectively, these 'downstream' and 'upstream' processes are always acting together although the level to which upstream or downstream processes dominates will vary over time and at different locations in the Channel. While it might seem convenient to separate these two drivers of inundation into 'tides' and 'floods', a comprehensive assessment of the inundation hazard requires that they be considered as acting together. Accordingly, the analysis which has been undertaken for this project combines them into a single inundation hazard, expressed as the water level recurrence frequencies at different locations, resulting from combined ocean and catchment effects. These relationships are set to change over time as mean sea levels rise and as Swansea Channel continues to evolve in response to training of the entrance in the late 1800's.

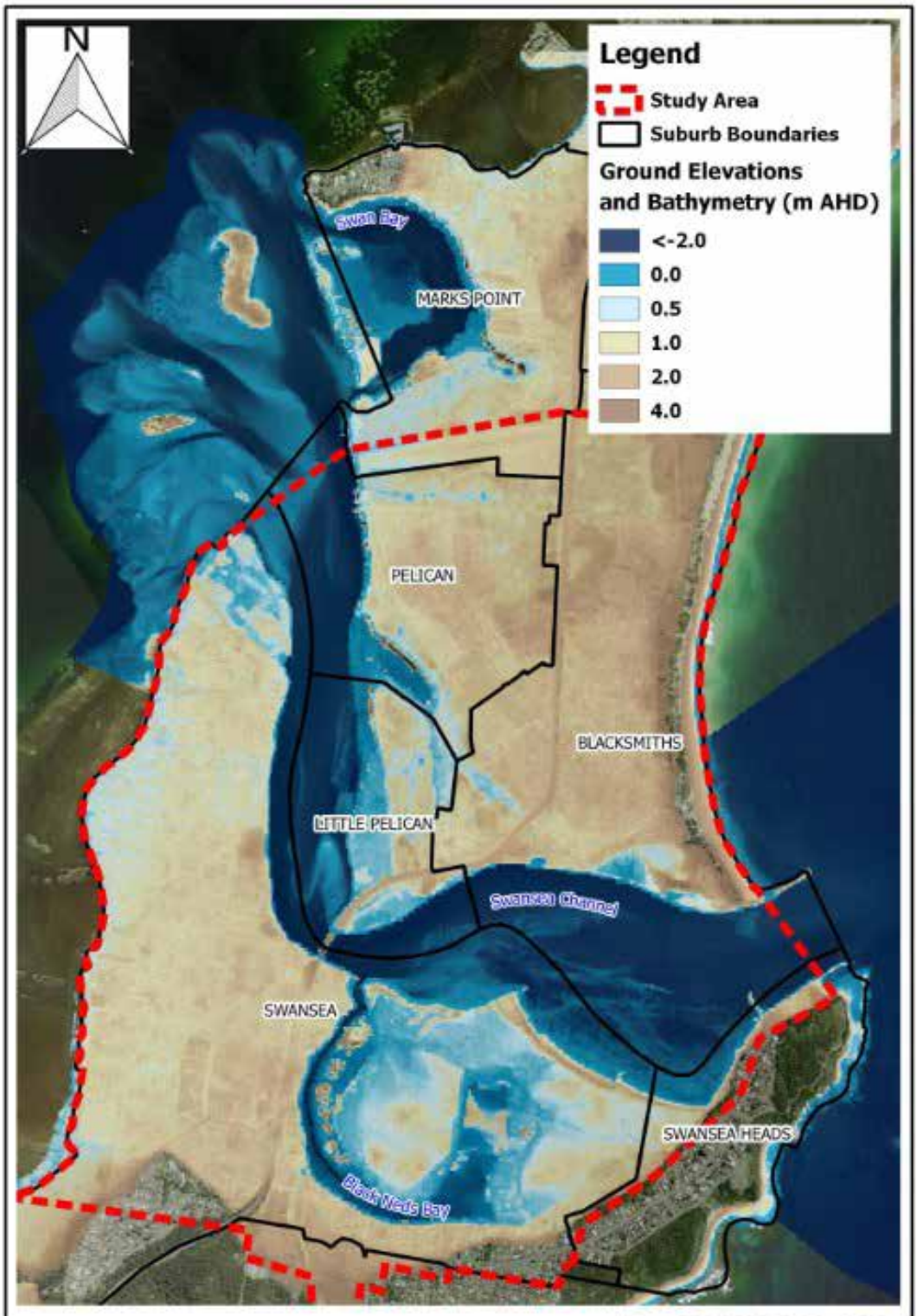


Figure E1: Locality Plan

Probabilistic Hazards for Pelican, Blacksmiths and Swansea

REV	DRAWN	CHECK
A	DJW	DJW

GIS File:\Projects\P00055 LakeMacquarieWaterLevelsHazard\Outgoing\Figures\FigureE1 LocalityPlan.qgs

Salients

Regardless of the process dominating water levels, when water breaks the banks of Swansea Channel, or backs up along the stormwater system, the inundation hazard will tend to arise gradually. Previous flood model simulations have indicated that flow velocities tend to be mild and flooding is largely from water backing up from the Channel. Conversely, flow within Swansea Channel itself can be swift and deep. Inundation does not tend to last for longer than around 12 hours, on account of tidal effects in the Channel, which help the inundated suburbs to drain. Pools of water will remain in isolated areas as the water drains, depending on local topography.

Monte Carlo Modelling Approach

While the study has focussed on the derivation of probabilistic hazards (Chapters 3 – 5), some effort has also been spent on calculating the "damages" resulting from inundation events of different magnitudes (Chapter 6). These two aspects of the study represent the "Likelihood" and "Consequences" aspects of risk assessment, respectively.

The probabilistic hazards have been determined using Monte Carlo modelling. The Monte Carlo modelling process is shown schematically in Figure E2.

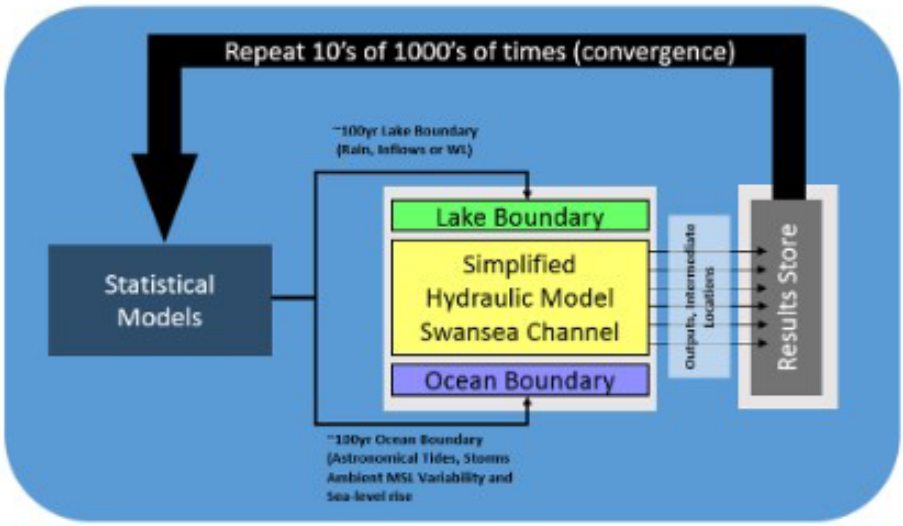


Figure E2 Schematic showing Monte Carlo Modelling Process

The Monte Carlo process involved the simulation of 400,000 individual statistically determined future scenarios, with each of those extending from 2020 and 2120. A time stepping, but very simple by today's standards, hydrodynamic model was used in each of these simulations to simulate water level response at several locations along Swansea Channel for each of those simulations.

Boundary conditions for each simulation comprised (i) a 100-year time series of inflow to the Lake and (ii) a 100-year time series of ocean water level, for the upstream and downstream

boundaries, respectively. Before each simulation was executed, these time series were randomly sampled using statistical models that were based on (i) the analysis of existing data and (ii) sea level rise projections for Lake Macquarie, as derived from the latest assessment report from the Intergovernmental Panel on Climate Change (IPCC AR5).

The ocean boundary was sampled using a statistical model combining the following components:

- Astronomical tides: These are regular and predictable (these were the same for every simulation)
- Tidal Anomalies: Representing short term variations of actual tides from the expected astronomical tide due to processes such as storms. The statistical model which generated this component was based on comprehensive analysis of the historical tide record from Fort Denison.
- "Annual" variability of mean sea level: As caused by broad scale climatic processes such as the southern oscillation (El Nino / La Nina cycles) and the Interdecadal Pacific Oscillation (IPO). These variations were found to be well represented by a first order autoregressive (AR(1)) model.
- A future sea level rise trajectory which, following the advice contained in the latest IPCC report (AR5) and as indicated by several researchers, assumed a normal distribution of likelihood for a given Representative Concentration Profile or RCP.

The lake boundary was sampled using a simplified representation of lake hydrological response. Analysis of larger floods (greater than the flood which would occur around once a year, on average), found that the increase in water level, above that caused by the ocean was approximately linearly related to the volume of rainfall in historical rainstorms at the Barnsley Pluviometer (rain gauge). Using random sampling of rain storm volumes from data supplied by the Bureau of Meteorology in accordance with the latest (2016) revision of Australian Rainfall and Runoff, and a Poisson model for randomly generating the gaps between significant rain storms, a time series of inflow volumes to the Lake was generated for each simulation.

Finally, three overriding "Scenarios" (400,000 simulations each) were modelled, with the following assumptions:

1 RCP8.5: Herein, the range of sea level rise trajectories reported by the IPCC for RCP 8.5 was used. This scenario is most consistent with the sea level rise projection presently adopted by Council.

2 Three Combined RCP's: The trajectories for sea level rise were generated assuming that RCPs 8.5, 6.0 and 4.5 are equally likely. This scenario is more representative of the full range of uncertainty expressed by the IPCC, noting that differences in possible future greenhouse gas concentrations are allowed for. The lowest RCP reported by

the IPCC (RCP 2.6) was not considered realistic, as the thresholds for that RCP have almost been exceeded and it seems highly unlikely that this situation will be recovered over the time frame with which this study is concerned.

3 Three Combined RCP's + Morphological Change: This scenario adds to Scenario 2 by allowing the conveyance of Swansea Channel to gradually increase over time. This recognises that the Channel is presently deepening and widening in response to the entrance being trained in the late 1800's. It does not aim to replicate ongoing meander of the channel and is a simplified representation of morphological change based on the results of previous research.

Damages Assessment

To examine the consequences of different future scenarios, a "damages" assessment has been completed using the concept of "Annualised Average Damages" (AAD) which is adopted as a standard approach for floodplain management in New South Wales when assessing the net benefits of potential flood mitigation strategies. In the case of a varying climate, however, the AAD values are also expected to vary with time. The damages assessment presented herein is incomplete but contains the dominant sources of damages to constructed elements of the three suburbs being assessed. These have been assessed using the follow methods:

- Residential Damages: These have been assessed using the method presented in guidance published by the NSW Government. An additional sensitivity assessment was completed using recently published methods of Geosciences Australia.
- Non-Residential Buildings: The methodology outlined in the United Kingdom's Multi-Coloured Manual has been applied to assess damages to a range of non-residential buildings, including emergency services, commercial and schools.
- Caravan Parks: Damages to caravan parks have been assessed by considering the impact to caravans and cabins separately. Sample above ground floor elevations were measured in the field and referenced to AHD ground elevations derived from LiDAR data. The damage model for cabins and caravans assumes that these require complete replacement if over floor flooding occurs.
- Public Infrastructure: The assessment has focussed on the key assets managed by Council, including roads, the stormwater systems, parks, and foreshore reserves. A bespoke methodology needed to be developed considering the physical conditions and nature of flooding processes across the study area. The methodology was derived following research and meetings with key staff within Council. Background information and a discussion of the approach is presented in Appendix C.

The cost benefit assessment that will follow the present study will involve improvement upon these damage models and a more complete economic assessment. The way in which other buried services will be affected by increasing water levels and how these need to be considered in the context of the guidance for cost benefit analysis published by the NSW state

government will also be addressed by the cost benefit assessment. Accordingly, the damages assessment provided here needs to be considered preliminary and subject to being superseded soon.

Summary Results

Using the results from a more detailed two-dimensional model developed as part of the Lake Macquarie Waterway Flood Study (WMA Water, 2011a), a set of "Inundation Precincts" was determined. Across these precincts, the peak water level during inundation events can be considered similar (within +/- 2-3cm). Those precincts are shown in Figure E3.

Interim results are presented throughout the report where appropriate. However, a key deliverable from the study is a set of pre-processed results files from the Monte-Carlo simulations executed as part of this study alongside some sample computer code to access those files. Summary results have been prepared to show how the calculated total AAD values for each of the inundation precincts are expected to vary over time. As an example of the types of outputs that can be derived from the study deliverables, these outputs are presented in Figure E4.

It is emphasised that these "damage" estimates do not include the additional cost that would be associated with adapting services, such as sewer, water, telecommunications, or gas. Similarly, the damages assessment has been based on only 8 recurrence frequencies and the CBA should expand this to include a greater range of frequencies, particularly for more regularly occurring events. The damage estimates do not include 'intangible' (non-monetary) damages. Indirect damages have been included for residential, commercial, and public buildings, but not for caravan parks. For roads, stormwater, parks and foreshore reserve, indirect damages are also not included. Some consideration of the nuisance arising, for example, of having an area of park that is only usable some of the time (before it becomes completely unusable) or from complete reconstruction of road pavements and associated stormwater should be considered as part of the subsequent economic assessment.

It is clear from Figure E4 that the Lake Precinct contributes a substantial proportion of the total damages. There are a few reasons. Firstly, that Precinct is relatively large and low lying. It follows that roads, stormwater and parks will be influenced early by sea level rise. Secondly, that Precinct has at least 50% more houses than any other precinct. Thirdly, the average floor elevation in that Precinct is some 300mm lower than in any other precinct. These factors combine such that the total damages for the Lake Precinct seems disproportionately large. However, the results do indicate that the Lake Precinct, occupying much of the Swansea Peninsula, will required relatively early action when adapting to future sea level rise.

Figure E3: Extents of Hydraulic Inundation Precincts

0 0.25 0.5 0.75 1 km

APPROX SCALE

Probabilistic Hazard Assessment for Pelican, Blacksmiths and Swansea	REV B	DRAWN DW	CHECK DW	Salients
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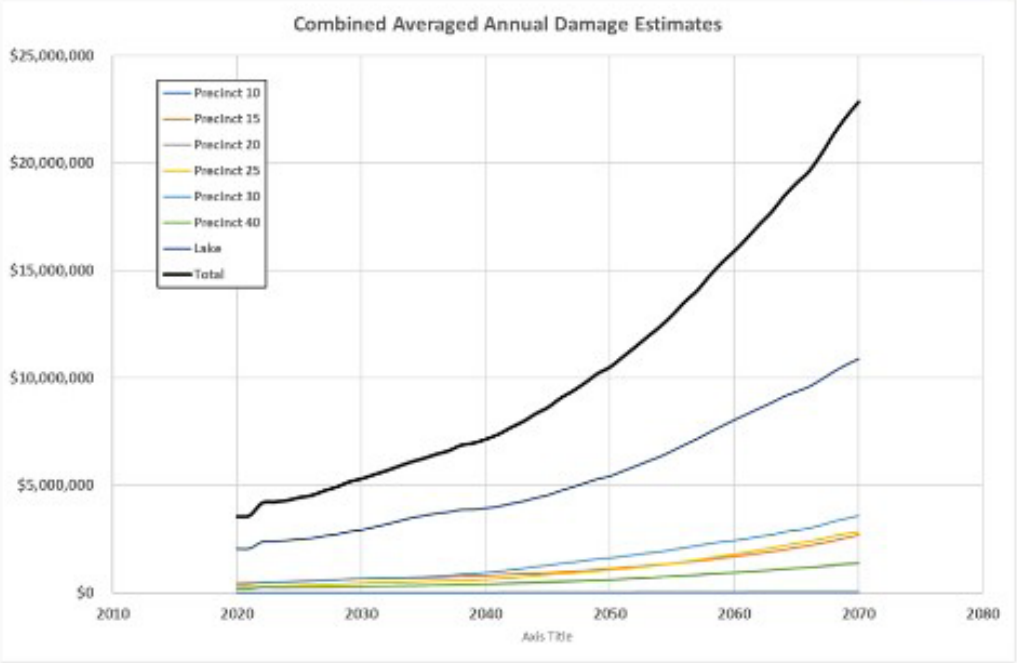


Figure E4 Variation of AAD for Each Inundation Precinct over Time for 3RCP + Morphology Scenario

Beyond the delivery of probabilistic model results files, tables of water level exceedance probabilities have also been delivered, for application in the Cost Benefit Analysis. To enable more robust assessment of damages resulting from relatively high frequency events the monthly maximum water levels from each individual model simulation (of which there were 400,000) were post processed with the extracted values treated as an empirical distribution. For each future year, and for each precinct, a water level was thus determined in terms of "EY" or expected number of occurrences per year. Given that cost benefit analysis works will be adopt analysis of annual series, the EY provides a means to correctly calculate damages for more frequent events (compared to AEPs). For example, a water level which would be expected to be exceeded at least once during half of the months in a year has an EY of 6, but an AEP of 99.75. The resulting damages from such an event need to be multiplied by 6 instead of 0.9975 when assessing the annual time series of damages in the CBA. The relationship between EY and AEP is presented, as a reference for the different event frequencies calculated for this study in Table E1.

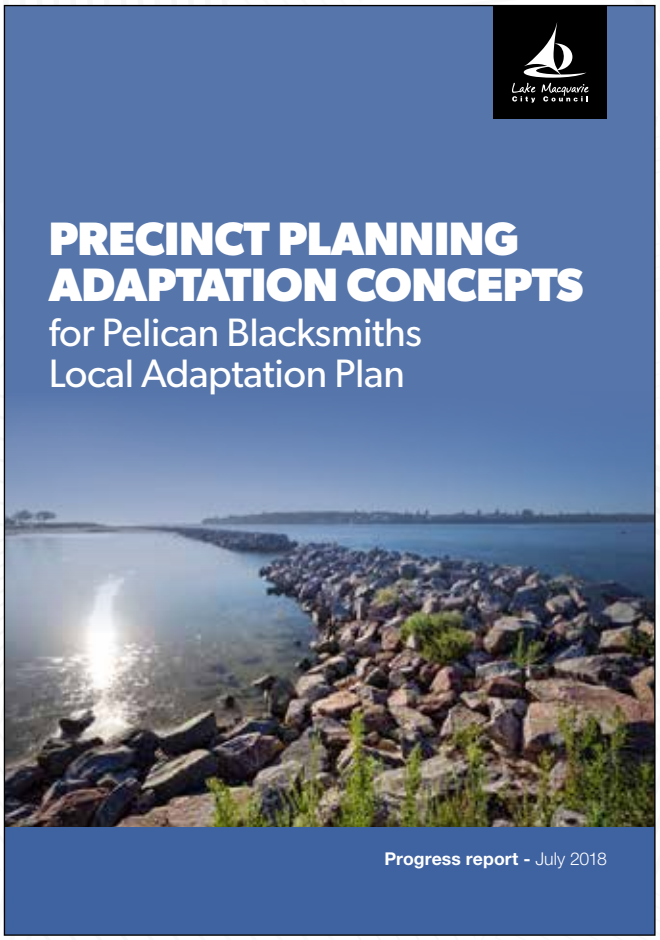
Table E1 Comparison Between AEP and EY Values for Events extracted from Probabilistic Model Results Files

Annual Exceedance Probability (AEP %)	Expected Occurrences per Year (EY)
99.75	6.0000
98.17	4.0000
95.02	3.0000
86.47	2.0000
63.21	1.0000
39.35	0.5000
18.13	0.2000
10.00	0.1054
5.00	0.0513
2.00	0.0202
1.00	0.0100
0.50	0.0050
0.20	0.0020
0.10	0.0010
0.05	0.0005
0.02	0.0002
PMF	0.0000

APPENDIX 5

Pelican and Blacksmiths working group preliminary options assessment

Appendix 5.1:
Pelican Blacksmiths Adaptation Concepts



1 Pelican residential precinct

1.1 What do we know and value about Pelican

around 900 residents
around 400 houses
1 school
1 Jetty and Marine Rescue
2 Boat ramps
Shops, RSL and recreational facilities
Quality Lifestyle

1.2 Why adapt Pelican residential area?

Sea levels are projected to continue to rise at an increasing rate. Warmer temperatures are predicted to bring more frequent and intense flooding and storm events. For Pelican residential area, this means higher flood levels will increasingly affect local roads, drains and eventually private property.

Groundwater is predicted to rise with sea level rise, affecting drainage and other infrastructure, such as roads and building foundations. Homes, roads and community facilities are designed to last for 50 years or more, so we need to plan for future change.

2 Blacksmiths residential precinct

2.1 What do we know and value about Blacksmiths

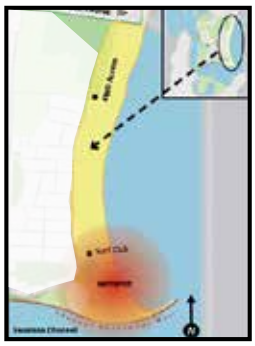
around 1800 residents
around 800 houses
1 school
1 Holiday Park
1 Reserve land adjoining the golf club
Recreational facilities
Quality Lifestyle

2.2 Why adapt Blacksmiths residential area?

Sea levels are projected to continue to rise at an increasing rate. Warmer temperatures are predicted to bring more frequent and intense flooding and storm events. For Blacksmiths residential area, this means higher tides and storm surge in the channel. The seawall and foreshore area need to be maintained as a levee to prevent tides reaching private properties. Associated flood levels will increasingly affect local roads, drains and eventually private property.

Groundwater is also predicted to rise with sea level rise, affecting drainage and other infrastructure such as sewers, road-base and building foundations. Homes, roads and community facilities are generally designed to have an asset life of around 50 years and as such controls will need to be put in place to manage these assets sustainably.

3 Beach and dunes precinct



3.1 What do we know and value about Blacksmiths beach and dunes

Highly valued by the local community and a significant regional tourism destination
Dunes ranging from three to seven metres in height providing a defensive buffer for properties
Home to important dune vegetation – an active dune rehabilitation program providing stability to the dunes
Swansea Belmont Surf Life Saving Club
12 properties along Ungala Road north of Surf Club
Other assets include Helipad, Grannies Pool and recreational facilities

3.2 Why adapt the beach and dunes area?

Sea levels are expected to continue to rise at an increasing rate. More frequent and intense storm and coastal erosion events also are predicted. For Blacksmiths Beach, a predicted sea level rise of 0.9 metres could result in beach recession of up to 80 metres in some areas by the end of the century under a "do nothing" scenario. Dune overtopping and/or "blowouts" have also been recorded at a number of locations along Blacksmiths Beach in the past.

Without adaptation actions, beach recession, dune depletion and more frequent and intense storm surge may result in an increased frequency of wave over-topping of the dunes eventually putting homes and other assets at risk. Timely and well managed adaptation can help in managing this risk.

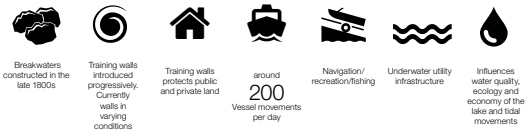
4 Environmental land precinct

4.1 What do we know and value about the Pelican and Blacksmiths environment?

Wetland vegetation during high tide – December 2016.

5 Channel precinct

5.1 What do we know and value about the Swansea Channel?



5.2 Why adapt Swansea Channel?

The Channel is dynamic and has been actively migrating since ocean entrance training works in the late 1800s. We can observe this movement in the deterioration of the channel training wall and active foreshore erosion (for example, Milanos at Pelican and further along Pelican Foreshore).

As sea levels rise, the depth and width of the channel will increase, with a corresponding increases in the volume and velocity under the bridge. Loss of the channel training wall will result in further erosion and potential loss of environmental land and built assets in adjoining areas. As the channel forms a boundary for all other precincts, its management and adaptation needs to be aligned with the adaptation of other precincts. For example, stabilisation of the Pelican Foreshore reserve.

https://shape.lakemac.com.au/14791/widgets/126337/documents/83597

6 Pacific Highway and Swansea Bridge precinct

6.1 What do we know and value about the Pacific Highway and Swansea Bridge?

6.2 Why adapt the Pacific Highway and Swansea Bridge?

Sea levels are projected to continue to rise at an increasing rate. Under current projections, the Pacific Highway and Swansea Bridge will be impacted by higher floods and tides from around the 2040s onwards. This means:

- potential flooding of sections of the Pacific Highway;
- the pedestrian underpass of the bridge will be inundated;
- the clearance for boats under the bridge will reduce; and
- the water velocity under the bridge will double.

Pelican and Blacksmiths Preliminary Options Assessment (N=56)

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW1	Stabilise public foreshore (continue to liaise with State Government on design, including public access to Naru Point.	Channel Dynamics	Pelican	Yes	Foreshore stabilisation included in primary precinct adaptation concept. Need to address as soon as possible.	Yes	Already being managed/addressed within Council frameworks/ managmenet. Modelling and design work underway during 2018 as part of Council's Pelican Foreshore Stabilisation Project. Therefore not for MCA/CBA but consider in separate/ related study, LAP and CMP
PB-ONW2	Move Pelican boat ramp landward or relocate boat ramp and free up foreshore reserve. Leave boat ramp where it is.	Channel Dynamics	Pelican	Yes	Assessed as separate Council project in 2017/18 examining replacement of damaged boat ramp. Design and construct tender issued early 2018. Planned completion late 2018.	No	Replacement boat ramp constructed 2018/19 FY
PB-ONW3	Fill foreshore reserve to maintain ground levels above lake levels.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, Groundwater, and Channel Dynamics	Pelican	Yes	Considered as part of group's primary adaptation concepts for precinct (sequencing). Consider in Cost Benefit Analysis - late 2018.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW4	Protection options for Pelican foreshore plus gradually fill residential and at time of redevelopment, raise roads and introduce swales for drainage as the old pits and pipes network fails, where sufficient road width and appropriate topographical conditions exist. Ensure that a regular maintenance program is in place to maintain these drainage swales.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, Groundwater, and Channel Dynamics	Pelican	Yes	Included in Precinct concepts.	Yes	
PB-ONW5	Decommission part of Soldiers Road with no existing residences; provide room for wetlands/cabbage palm forest; divert maintenance cost savings to other protection options.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, Groundwater, and Channel Dynamics	Pelican	Yes	Passes group criteria but should be evaluated against the preferred option to raise over time. Adaptation plan to consider incorporating biodiversity enhancement aspects	Yes	Requires further examination / research
PB-ONW6	Protection options for Beach, Dunes and Channel Training Wall (protect the boundaries), plus gradually fill residential and at time of redevelopment, raise roads and introduce swales for drainage as the old pits and pipes network fails, where sufficient road width and appropriate topographical conditions exist. Further detail required on sequencing principles and design.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics and Coastal Hazards	Blacksmiths	Yes	Primary concepts have started to address sequencing principles. This is a cross-cutting option related to Blacksmiths residential, beach and dunes and channel. Consider within context of the Cost Benefit Analysis and final draft LAP for public exhibition.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW7	Mankilli Street and drains If 'protect/accommodate' adaptation pathway is in play, raise Mankilli Street above projected hazard and reconfigure drains if have not already. AND Use elevated wider swale drains (rain gardens) as opposed to pits and pipes and kerb and gutter.	East Coast Lows and Storm Surge,Tidal Inundation, and Channel Dynamics	Blacksmiths	Yes	Primary concepts have started to address sequencing principles. Consider within context of the Cost Benefit Analysis and final draft LAP for public exhibition.	Yes	
PB-ONW8	Parts of all other roads south of Maneela Street If 'protect/ accommodate' adaptation pathway is in play, and if roads have not been raised or other adaptation options have been introduced to manage the hazards, raise roads.	East Coast Lows and Storm Surge,Tidal Inundation, and Channel Dynamics	Blacksmiths	Yes	Primary concepts have started to address sequencing principles. Consider within context of the Cost Benefit Analysis and final draft LAP for public exhibition.	Yes	
PB-ONW9	To prevent further erosion after erosion events, use temporary sand/geofabric bags for beach protection.	East Coast Lows and Storm Surge, and Coastal Hazards	Beach and Dunes	Yes	Agree – touched on in primary options – and can be undertaken as Emergency Protection Works under Coastal SEPP.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW10	Restrict vehicle beach access to dunes south of Surf Club, including access for commercial fishing operations. Manage/restrict beach vehicle access north of surf club.	Coastal Hazards (?)	Beach and Dunes	Yes	Included in the Beach and Dunes Precinct as part of seasonal/ongoing management regarding events and Licencing conditions.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW11	Defensive structures south of Boikon Street, such as a seawall or artificial reef, or extend the breakwater.	East Coast Lows and Storm Surge, and Coastal Hazards	Beach and Dunes	Yes	Is subject to ongoing review and monitoring before action is to be considered.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW12	New surf club west, allow dunes room to recede and maintain natural buffer. Revisit artificial defensive structures later.	East Coast Lows and Storm Surge, and Coastal Hazards	Beach and Dunes	Yes	Is subject to review and monitoring before action is to be considered. Timing depends on success of prior actions and timing of surf club renewal. Note: Condition assessment of surf club foundations currently being undertaken.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW13	Extend southern breakwater (on south side of channel) to help protect northern breakwater.	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Beach and Dunes	Yes	Not thoroughly assessed – suggest outside of scope LAP. High cost, high risk requiring expertise. Suggest consider option in future review of LM Coastal Management Program 2021.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW14	Continue above actions and investigate and construct defensive structures north of Boikon Street (surf club) in areas of potential dune collapse during inundation events.	East Coast Lows and Storm Surge, and Coastal Hazards	Beach and Dunes	Yes	Potential secondary option subject to ongoing review and monitoring. Need to consider feasibility of structure/s and also consider 9 mile beach as a holistic system.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW15	Reduce/redesign the many beach access paths to reduce dune damage and increase vegetation cover. Include signage for education.	East Coast Lows and Storm Surge, and Coastal Hazards	Beach and Dunes	Yes	Included in Blacksmiths Beach Masterplan.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-ONW16	Clear debris from Byrnes Cycleway when reported; install signage; include upgrade in relevant plans and policies, undertake design work and construct when asset life reached and/ or inundation unacceptable. Raise Byrnes Cycleway. If upgrade delayed due to funding constraints, continue to clear debris when reported.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, Groundwater, and Channel Dynamics	Environment	Yes	Will form part of ongoing asset maintenance (business as usual), however, will need to considered in the context of asset life and future replacement/raising.	Yes	Likely part of existing and ongoing Council monitoring and management - BaU?

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW17	Repair/raise training wall, stabilise foreshore, boat ramp wall requires attention	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Channel	Yes	Include in broader strategy to monitor, review and maintain entrance channel – connection to Cost Benefit Analysis and coastal management program	Yes	
PB-ONW18	Build new seawall alongside Ungala Road parallel to channel – consider raising seawall until fails assessment criteria. Note: training walls are designed for overtopping by waves but require ongoing maintenance.	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Channel	Yes	Consider in broader strategy to monitor, review and maintain entrance channel – connection to Cost Benefit Analysis and coastal management program.	Yes	
PB-ONW19	Open breakwall for water to flow into Granny's Pool.	none	Channel	No	Would reduce resilience of the area.	No	
PB-ONW20	Build new training wall between Lucy's wall and the bridge.	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Channel	No	Outside of scope, not assessed. To be considered as part of Swansea LAP	No	Not part of the Pelican/Blacksmiths area and likely considered in Swansea and surrounds LAP
PB-ONW21	Build a feature jetty with restaurants, etc. Can such a development be linked with bridge maintenance?	none	Channel	No	Outside of scope, not assessed.	No	
PB-ONW22	Create a diversion channel under the Pacific Highway north-east of Swansea bridge to reduce flow under the bridge.	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Channel	No	Considered previously in LM Waterway Flood Study- not support. Outside of scope of LAP not assessed.	No	Outside scope andnot supported by previous studies

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
PB-ONW23	Construct Channel entrance barrage/tidal floodgates and/ or deepen/dredge entrance channel to increase flow.	East Coast Lows and Storm Surge,Tidal Inundation, Coastal Hazards, and Channel Dynamics	Channel	No	This option was considered and is not practical due to the cost and impact on flooding i.e. potential effect of trapping Lake floodwaters if raised during storm surges.	No	Not supported as economically unfeasible
PB-ONW24	Re-route channel west, to ease landward movement of Pelican Foreshore.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, and Channel Dynamics	Pelican	?	Not fully assessed in Precinct Concept Plan. See channel options. Modelling and design work for Council's Pelican Foreshore Stabilisation Project may consider this.	No	Likely part of Pelican Foreshore or CMP;

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Planning and Development Controls							
PB-PDC1	Assisted relocation only for properties at risk from 'possible' channel evolution, and conversion of part of Lakeview Parade to foreshore park to compensate for any loss of public reserve from foreshore stabilisation works.	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican	No	Requires further analysis - does not meet Plan objective for directly affected households. Consider compensation/ funding. Ensures ongoing access to public recreation land. Consider in Cost Benefit Analysis planned late 2018.	Yes	Consider MCA/CBA - requires further investigation
PB-PDC2	Allow recreational foreshore land to retreat with channel evolution and sea level rise. This option is linked to designing and implementing a compensation scheme for landowners.	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican	No	Potential long-term option beyond immediate options. Does not meet current LAP objective and criteria. Feasibility would need to be further investigated. Consider in current foreshore design project, also flag in Cost Benefit Analysis late 2018.	Yes	Consider MCA/CBA - requires further investigation
PB-PDC3	Convert land currently zoned as medium density residential (3-4 storeys) to low density residential, to reflect existing character of Pelican and to ensure new development is more easily adaptable to changing conditions (e.g. faster rates of sea level rise than we are currently planning for).	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican & Blacksmiths	Yes	Potential long-term option beyond immediate options, particularly in areas without sea level constraints. Requires further investigation, feasibility and cost benefit analysis in consultation with relevant stakeholders, including SES, and in the context of land use planning reforms (LEP/DCP).	Yes	
PB-PDC4	Retain medium density residential zones but designs must allow building to be adapted over time, e.g. bottom floor redundancy (relevant to Pelican and Blacksmiths).	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican & Blacksmiths	Yes	Already underway by means of LM Flood Resilient Housing Guideline. Consider further development by means of secondary option. Further modelling needed – consider implications evacuation planning – public safety.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Planning and Development Controls							
PB-PDC5	All new low-density residential development must be adaptable over time (applies Pelican and Blacksmiths residential areas).	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican & Blacksmiths	Yes	Already underway by means of LM Flood Resilient Housing Guideline. Consider further development by means of secondary option. Further research needed – consider implications evacuation planning – public safety.	Yes	
PB-PDC6	For land at risk – new low-density development with a 50-year or longer useful asset - life new planning controls and floor levels already apply.	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican & Blacksmiths	Yes	Investigate potential changes to DCP to support adaptation planning in area i.e. develop new Area Plan once the LAP is adopted. Ensure floor levels and evacuation planning reviewed to take into account the most recent scientific advice e.g. IPCC	Yes	Largely part of BaU - not for MCA/CBA, though consider in LAP
PB-PDC7	Aitchinson Reserve not raised, to become detention basin in small flood events and eventually a wetland park. Decommission part of Lakeview Parade adjoining Awabakal Reserve and divert maintenance cost savings to other protection options.	Channel Dynamics, Tidal Inundation, and Lake Flooding	Pelican	Yes	Not assessed, though adaptation plan to consider incorporating biodiversity enhancement aspects. Consider in context of 2015 report by Umwelt: “It’s all uphill from here – preparing Lake Macquarie Wetlands for Retreat”.	Yes	Consider broadly in MCB/CBA and future studies
PB-PDC8	Existing low density development (assets that have not been redeveloped under above planning controls): Introduce incentives for redevelopment above hazard.	Tidal Inundation	Blacksmiths	Yes	Primary concepts have started to address sequencing principles. Consider within context of the Cost Benefit Analysis and final draft LAP for public exhibition.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Maintenance, Monitoring and reporting							
PB-MMR1	Determine if Local Adaptation Plan requires revision in line with new information – identify new land at risk and apply planning controls to accommodate hazard as appropriate.	All	Blacksmiths	Yes	Agree, ensure floor levels, planning controls and evacuation planning reviewed taking account of most recent scientific advice e.g. IPCC and monitoring review.	Yes	
PB-MMR2	Coastal Zone Management Plans and programs need reviewing.	East Coast Lows and Storm Surge, Coastal Hazard, and Emergency Response	Beach and Dunes	Yes	NSW Government coastal reform package commenced April 2018. Council is committed to aligning its programs to this framework.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU
PB-MMR3	Monitor beach recession, height of dunes and condition of Blacksmiths Breakwater.	East Coast Lows and Storm Surge, Coastal Hazard, and Emergency Response	Beach and Dunes	Yes	Council aims to deliver this data to the community in a manner that is easy to access and understand.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU
PB-MMR4	Regular condition assessments of channel training wall.	East Coast Lows and Storm Surge, Channel Dynamics, Coastal Hazard, and Emergency Response	Channel	Yes	Include - Council to liaise with Crown Lands.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU
PB-MMR5	A detailed survey of the Channel should occur at every 5-10 years to monitor evolution and deepening	East Coast Lows and Storm Surge, Channel Dynamics, and Coastal Hazard	Channel	Yes	Include monitoring and evaluation in cost benefit analysis.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Maintenance, Monitoring and reporting							
PB-MMR6	Monitor impact of channel dredging on foreshore, channel evolution and erosion trends.	East Coast Lows and Storm Surge, Channel Dynamics, and Coastal Hazard	Channel	Yes	Include in broader strategy to monitor, review and maintain entrance channel – connection to Cost Benefit Analysis and coastal management program.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU
PB-MMR7	A groyne condition assessment is part of the Coastal Zone Management Plan and will be included in the Adaptation Plan's ongoing monitoring regime.	East Coast Lows and Storm Surge, Channel Dynamics, and Coastal Hazard	Channel	Yes	Council undertook a Pelican foreshore groyne condition assessment in early 2018. Consider in broader strategy to monitor, review and maintain entrance channel – connection to Cost Benefit Analysis and coastal management program.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU
PB-MMR8	Continue to implement Coastal Zone Management Plan CZMP) actions relevant to Local Adaptation Plan including but not limited to: · Further modelling of hazards. · Dune nourishment and rehabilitation. · Beach scraping after storms to increase dune volume/ recovery. · Audit Surf Club foundations. · Monitor dune heights and condition of Blacksmiths Breakwater.	East Coast Lows and Storm Surge,Tidal Inundation, Lake Flooding, Coastal Hazard, and Channel Dynamics	Beach and Dunes	Yes	The CZMP going forward will reflect objectives of the Pelican and Blacksmiths LAP.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP
PB-MMR9	Recurrent storm event dune maintenance options, e.g. beach scraping, nourishment and maintenance.	East Coast Lows and Storm Surge,and Coastal Hazard	Beach and Dunes	Yes	Monitoring of beach recession, height of dunes and condition of the breakwater are essential. New technology will assist with more regular/accurate monitoring and reporting.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Piloting, Research and Innovation							
PB-PRI1	Lower the water table by planting paperbark and tea trees (also relevant Blacksmiths precinct).	Groundwater	Pelican & Blacksmiths	Yes	Suggest option of limited effectiveness in terms of water table, though broader range of benefits – however, adaptation plan to consider incorporating biodiversity enhancement aspects	Yes	Suggest option of limited effectiveness in terms of water table, though broader range of benefits – however, adaptation plan to consider incorporating biodiversity enhancement aspects
PB-PRI2	Improve design of sewer system to prevent failure in floods (also relevant Blacksmiths precinct).	East Coast Lows and Storm Surge,Tidal Inundation, and Lake Flooding	Pelican & Blacksmiths	Yes	Council has Memorandum of Understanding with Hunter Water and will include reference to infrastructure in the final LAP. Council is working with Hunter Water to identify and treat systems where sewer surcharge is a high risk	Yes	
PB-PRI3	Investigate the threshold at which drainage adjoining Mankilli Street will fail to service a range of different sized flood events.	East Coast Lows and Storm Surge,Tidal Inundation, and Lake Flooding	Blacksmiths	Yes	Research initiated through 2D modelling project, and probabilistic hazard assessment – suggest progress to Cost Benefit Assessment.	Yes	
PB-PRI4	Investigate and build protective levee, tidal flaps (Ungala Road) to allow more time for landowners to fill land over time.	East Coast Lows and Storm Surge,Tidal Inundation, and Lake Flooding	Blacksmiths	Yes	Primary concepts have started to address sequencing principles. Consider within context of the Cost Benefit Analysis and final draft LAP for public exhibition.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Piloting, Research and Innovation							
PB-PRI5	Investigate the economic, social and environmental impact of higher tides and floods on other parts of the City as a result of losing Blacksmiths, Pelican and Swansea to beyond a sea level rise of 1.1 metres. Review studies examining tidal impact on lake and foreshore suburbs also ecological impact on the Lake.	East Coast Lows and Storm Surge,Tidal Inundation, and Lake Flooding	Beach and Dunes	Yes	To be considered when scoping and undertaking the Cost Benefit Analysis project late 2018.	Yes	
PB-PRI6	Managed raising of wetlands to maintain above sea level and retain flushing necessary for wetland environment.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	Yes	Consider in broader strategy to monitor, review and protect ecosystems – connection to Cost Benefit Analysis and coastal management program. Consider in context of 2015 report by Umwelt: "It's all uphill from here – preparing Lake Macquarie Wetlands for Retreat".	Yes	
PB-PRI7	Allow wetlands to move landward as lake levels rise.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	Yes	Consider in broader strategy to monitor, review and protect ecosystems – link to Cost Benefit Analysis and coastal management program. Consider in context of 2015 report by Umwelt: "It's all uphill from here – preparing Lake Macquarie Wetlands for Retreat".	Yes	
PB-PRI8	Investigate – shallows become deeps but what is the effect on ecology and channel evolution; loss of ecology; habitat; 50 per cent drowned at 0.5m AHD.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	Yes	Monitor and update with IPCC updates and review. Community feedback indicates preference is to maintain as a natural foreshore for as long as possible.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Piloting, Research and Innovation							
PB-PRI9	Investigate cause of observed 'sink holes within the channel training wall.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Coastal Hazard	Environment and Channel	Yes	The training wall is critical to other options, like maintaining the boat ramp and helps to protect everything behind it. Maintaining the existing training wall is the preferred adaptation option. Contingency: a new wall or treatment between the wetland and Ungala Road / raising Ungala Road to act as a defensive structure in event of channel evolution with sea level rise and inundation of Boat hole wetlands.	Yes	
PB-PRI10	Any environmental land adjoining Pelican Inlet that is not currently wetlands is allowed to become wetlands.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	Yes	Consider in broader strategy to monitor, review and protect ecosystems – connection to Cost Benefit Analysis and coastal management program. Consider in context of 2015 report by Umwelt: "It's all uphill from here – preparing Lake Macquarie Wetlands for Retreat".	Yes	
PB-PRI11	Leave wetlands as they are; allow natural sedimentation and building processes to occur if these can keep up with rising sea levels. Wetlands adjoining airport are important drainage areas in short to medium term. May need to make some minor topographical changes to improve drainage management in the long term. Do not develop wetland areas further.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	Yes	Included as option within the Environmental Land Precinct. Consider in context of 2015 report by Umwelt: "It's all uphill from here – preparing Lake Macquarie Wetlands for Retreat".	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Piloting, Research and Innovation							
PB-PRI12	Offset lost wetlands with land reserved elsewhere as lake levels rise.	East Coast Lows and Storm Surge,Tidal Inundation, Channel Dynamics, and Lake Flooding	Environment	yes	Not assessed, looked to consider this option in the future. Consider in context of 2015 report by Umwelt: "It's all uphill from here – preparing Lake Macquarie Wetlands for Retreat".	Yes	
PB-PRI13	Investigate impermeable training wall to double as levee to protect against permanent/tidal inundation and ocean dominated flood events for Blacksmiths residential properties, while maintaining flushing of wetlands.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Coastal Hazard, and Tidal Inundation	Channel	Yes	Consider in broader strategy to monitor, review and maintain entrance channel – connection to Cost Benefit Analysis and coastal management program. This option would have a higher cost and risk relative to Ungala Road raising (primary adaptation concept).	Yes	
PB-PRI14	Do nothing.	None	Beach and Dunes	No	This option does not pass criteria – unmanaged retreat has a detrimental outcome on community and assets alike. The Cost Benefit Analysis will consider a "business as usual" scenario along with other options – Council and the community recognise that this is not the same as "do nothing".	No	Do nothing is not the same as BaU in the CBA. Do nothing not considered an acceptable option

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Regulation and compliance							
PB-RC1	Design and implement compensation and relocation scheme for Sunstrip Village and surrounding private land holdings. This could be independent of next option.	East Coast Lows and Storm Surge,Tidal Inundation, Groundwater, Channel Dynamics, and Lake Flooding	Pelican	Yes	Passes group criteria - Compensation scheme should be investigated, e.g. transferrable development rights.	Yes	Requires further examination / research
PB-RC2	Design and implement compensation and relocation scheme for Pelican residential land at risk. Note: Under this option, many people could still continue living in Pelican well beyond the 2090s, using current sea level rise projections.	East Coast Lows and Storm Surge,Tidal Inundation, Groundwater, Channel Dynamics, and Lake Flooding	Pelican	Yes	Passes group criteria - Compensation scheme should be investigated, e.g. transferrable development rights.	Yes	Requires further examination / research
PB-RC3	Assisted relocation Design and implement compensation and relocation scheme for residential land at risk.	East Coast Lows and Storm Surge,Tidal Inundation, Groundwater, Channel Dynamics, Coastal Hazard, and Lake Flooding	Blacksmiths	Yes	Considered in the Cost Benefit Assessment, managed retreat approach – monitor/review.	Yes	
PB-RC4	Limit boat speeds to prevent wash and erosion of Channel edge.	Channel Dynamics	Channel	Yes	Flag in Coastal Zone Management program. Ongoing liaison and enforcement Roads and Maritime Services. Consider existing Council committees/services.	Yes	Whilst outside scope of MCA/CBA - identified as possible action in LAP and/or upcoming CMP - also part BaU

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Advocacy and Industry Engagement							
PB-AIE1	Little Pelican State leased residential area becomes recreation reserve accessible by foot or boat.This option alludes to managed retreat for Little Pelican beyond 2090s (Above 1m sea level rise land is inundated).	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Groundwater, and Tidal Inundation	Pelican	No	If State Government lets the access road deteriorate, residents' waste may need to be collected by boat, meaning this process would be more expensive.Noted that the history of Little Pelican can be recorded to allow the heritage to be valued in a non-physical way.	No	
PB-AIE2	Residents form a collective, lobby Council and the State Government to expand medium density development zones for Pelican and Blacksmiths and court developers to purchase private land and raise the area in well-sequenced stages using development contributions.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Groundwater, and Tidal Inundation	Pelican & Blacksmiths	Yes	Discussed generally but not assessed by working group against criteria. Can a large development like this be as easily adapted to sea level rise as individual dwellings? Will existing residents want to move?	Yes	Requires further examination / research
PB-AIE3	Liaise with Hunter Water to determine risks and replacement schedule for water and sewer infrastructure.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Groundwater, Coastal Hazard, and Tidal Inundation	Beach and Dunes	Yes	Council has Memorandum of Understanding with Hunter Water and will include reference to infrastructure in the final LAP.	Yes	
PB-AIE4	Liaise with Roads and Maritime Services to determine timing of upgrade of Pacific Highway Swansea Bridge under a 'protect/ accommodate' adaptation pathway.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Groundwater, and Tidal Inundation	Highway/Bridge	Yes	Council to liaise with RMS and include reference to infrastructure in cost benefit analysis and final draft LAP.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Advocacy and Industry Engagement							
PB-AIE5	Raise Pacific Highway to maintain access during 100-year ARI flood events. May need to be combined with bridge upgrade.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Groundwater, and Tidal Inundation	Highway/Bridge	Yes	Council to liaise RMS and will include reference to infrastructure in cost benefit analysis and final draft LAP.	Yes	
PB-AIE6	Council liaise with Roads and Maritime Services and Crown Lands to improve navigational safety at the Blacksmiths Boat Ramp.	Lake Flooding, East Coast Lows and Storms, Channel Dynamics, Coastal Hazard, and Tidal Inundation	Channel	Yes	Include as option in final draft LAP for exhibition.	Yes	Whilst not for MCA/ CBA - Consider in LAP - Part of BaU

APPENDIX 6

Swansea and surrounds preliminary options assessment

Swansea and Surrounds Preliminary Options Assessment (N=53)							
ID/Call #	**Option**	**Hazard/s identified by council/ community**	**Location**	**Meets Working Group Criteria (Y, N, ?)**	**Assessment Response Note/s**	**Progresses to further assessment (Y, N)**	**Any further comment (Total Progressed, N = 45)**
On-ground Works							
S-OGW1	Raise/fill residential (private) houses and land	Multiple	All	Yes	In principle support, has been used in other areas. Adaptable over time when sequenced with other options. It is recommended that this option undergoes further analysis to determine the associated cost/ benefit. Additional analysis is required when considering the sequencing of raise and fill scenarios	Yes	
S-OGW2	Raise/fill areas of public land	Multiple	All	Yes	In principle support, has been used in other areas. Adaptable over time when sequenced with other options. It is recommended that this option undergoes further analysis to determine the associated cost/benefit. Additional consideration is required regarding the selection/ prioritisation of public areas (as per hazard or social value).	Yes	
S-OGW3	Raise and fill CBD by raising car park and building CBD in carpark - see planning/design	Multiple	Swansea CBD	Yes	In principle support, has been used in other areas. Adaptable over time when sequenced with other options. It is recommended that this option undergoes further analysis to determine the associated cost/ benefit. Additional analysis is required when considering the sequencing and timing of raise and fill scenarios	Yes	Look at combining with other CBD option S-PDC3

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
S-OGW4	Raise other roads and drainage	Multiple	All	Yes	Currently being investigated for priority roads/drainage. It is recommended that this option undergoes further analysis to determine priority locations and the associated cost/ benefit. Additional analysis is required when considering the sequencing of raise and fill scenarios	Yes	Consider in other sync with other options.
S-OGW5	Ramp fill of Swansea - i.e. elevate peninsula from midpoint to edges to allow for east/west drainage	Multiple	Swansea	Yes	This option describes a large scale (i.e. at least 3m raise at midpoint) raise and fill scenario. Requires further consideration of the significant social, environmental and economic costs.	Yes	considered not feasible as a large scale here and now measure; not for future investigation in future plan reviews
S-OGW6	Consider foreshore protection works as required - lake and channel - prepare for expected rises. This includes: - Building hard protection works along channel - Foreshore protection works on environmental areas (Coon Island) - Maintenance of existing damage - Raising foreshore protection walls as required - Managing erosion and improving stabilisation of foreshore and channel areas	Tidal inundation, flooding, and East Coast Lows	All	Yes	Included in current base case however requires reinforcement/priotisation within ongoing capital planning/budgeting.	Yes	Swansea group considered BAU though check in with Pelican group

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
S-OGW7	Build a structure across the channel ie: gate to regulate inflow/outflow. Location tbc	Tidal inundation, flooding, and East Coast Lows	All	Yes	Potentially significant environmental, economic and social impacts associated with this option.	Yes	
S-OGW8	Build a structure across the channel lock to regulate inflow/outflow to permit navigation. Location tbc	Tidal inundation, flooding, and East Coast Lows	All	Yes	Potentially significant environmental, economic and social impacts associated with this option.	Yes	
S-OGW9	Build a training wall along the full length of the channel - both sides to control the channel dynamics and tidal prism etc	Tidal inundation, flooding, and East Coast Lows	All	Yes	Dependent upon prioritisation within ongoing capital planning/budgeting. Potentially significant environmental, economic and social impacts associated with this option.	Yes	
S-OGW10	Dredge the channel to improve/manage the Channel dynamics	Nil	All	No	Dreding primarily a navigational measure. Studies have shown that large scale dredging results in an increase in the tidal prism which can worsen peak flood levels in the lake, channel and surrounding suburbs	No	suggest unlikely to pass SEPP criteria
S-OGW11	Construct an extra channel (second outlet to the ocean)	Nil	All	No	Studies have shown that a secondary channel would have limited water quality benefits and would result in an increase in the tidal exchange between the ocean and lake which can worsen peak flood levels in the lake and low-lying surrounding suburbs. Significant environmental, social and economic impacts associated with this option.	No	rejected at LMCZMP

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
S-OGW12	Dredge old channel between sand islands to allow a more natural and larger amount of water to get in and out of lake	Nil	All	No	Dreding primarily a navigational measure. Studies have shown that large scale dredging results in an increase in the tidal prism which can worsen peak flood levels in the lake, channel and surrounding suburbs	No	
S-OGW13	Replace existing bridge with one that accomodates future SLR ie: raise the level above existing bridge. May or may not widen	Multiple	All	Yes	In principle support. Adaptable over time when sequenced with other options. It is recommended that this option undergoes further analysis to determine the associated cost/ benefit.	Yes	
S-OGW14	Replace bridge with a high level overpass that boats can fit under	Multiple	All	Yes	Unlikely, doesn't reflect social and community values. Not the preferred bridge option. Significant impacts on Swansea public domain.	Yes	
S-OGW15	Replace bridge with a tunnel	Nil	All	No	This would not address the hazards.	No	
S-OGW16	Relocate the bridge to another location - TBC	Multiple	All	Yes	Unlikely, significant environmental and economic impacts of new bridge footprint. Not the preferred bridge option.	Yes	unlikely within life of plan
S-OGW17	Abandon bridge when damaged/end of life (use a ferry)	Nil	All	No	This would not address the hazards. Significant social and economic impacts	No	
S-OGW18	Build dykes and/or Levees without pumps	Tidal inundation, and East Coast Lows	All	No	Unlikely to work in isolation due to groundwater and flooding hazard.	No	consider with other channel/seawall controls

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
S-OGW19	Build dykes and/or Levees with pumping stations	Multiple	All	Yes	Unlikely to work in isolation due to groundwater and flooding hazard. Significant risk of pumping station failure during storm events lending to option failure. However, this option may be viable in smaller scale situations	Yes	consider with other channel/seawall controls - in spirit of integrated solution.
S-OGW20	Install pumps	Multiple	All	Yes	Unlikely to work in isolation due to groundwater and flooding hazard. Significant risk of pumping station failure during storm events lending to option failure. However, this option may be viable in smaller scale situations	Yes	requires engineering advice
S-OGW21	Utilise pumped storage to mitigate flooding. E.g. Filling abandoned mines or dams	Flooding	All	No	Significant environmental risk and unlikely to be feasible	No	
S-OGW22	Improve drainage in Swansea and Surrounding areas ie: improved stormwater infrastructure	Flooding	All	Yes	Included in current base case however requires reinforcement/priotisation within ongoing capital planning/budgeting.	Yes	operational
S-OGW23	Construct and install kerb and guttering to all roads	Flooding	All	Yes	This option in isolation is unlikely to address significant inundation or flooding hazard. Whilst it is noted that there is a strong community desire for kerb and guttering, this infrastructure is best suited to locations with appropriate fall. Difficult to adapt. This option would be considered when improving drainage in Swansea, however is likely to not be a preferred option in isolation.	Yes	requires engineering advice recommendation. Unlikely to be required to do a CBA for this

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
On-ground Works							
S-OGW24	Construct and install flood gates (sluice/weir etc) on pipe and/or channel drainage	Tidal Inundation, and East Coast Lows	All	Yes	Currently being trialled as short-term solution to nuisance tidal inundation in CBD. Feasibility of tidal gates is dependent upon large variation of tidal waters i.e. ocean side rather than lake side. Potential impacts need to be considered, including exacerbating flooding.	Yes	requires coastal engineering review/ assessment; also against CM Act and SEPP.
S-OGW25	Install Early Warning Systems to detect Tsunami	Flooding, and East Coast Lows	All	Yes	In principle support. Technically feasible and detection systems are presently available, however further analysis is required as to integrating tsunami warnings this into an Early Warning Network.	Yes	Council/SES et al can do
S-OGW26	Install a light board sign with high and low tides advertised on bridge tower	Tidal inundation, Channel Dynamics, and East Coast Lows	All	Yes	Requires engagement with RMS and other stakeholders.	Yes	
S-OGW27	Improve access in and out of Swansea Heads and Caves Beach during flooding. Improve evacuation methods/ access for Caves Beach during flooding or natural disaster	Flooding, and East Coast Lows	All	Yes	Liaise with Council, SES and other stakeholders regarding implementation.	Yes	
S-OGW28	Physical barriers for houses or businesses	Flooding	All	Yes	Subject to land use and overarching emergency management strategy as dictated by relevant stakeholders.	Yes	small scale/individual rather than larger capex.
S-OGW29	Divert water to dams and/or rainwater tanks	Flooding	All	No	Not feasible in this geographic location.	No	previously shown to be ineffective

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Planning and Development Controls							
S-PDC1	Improve planning and building regulations, innovative building designs	Multiple	All	Yes	Council to consider ongoing review and adjustment of planning and building instruments to allow for appropriate zonings and design/construction. What this may look like depends on the implementation of other options e.g. raise/fill	Yes	
S-PDC2	Relocate Swansea CBD to higher ground - involves abandoning current CBD and building elsewhere	Multiple	Swansea CBD	Yes	It is recommended that this option undergoes further analysis as a last resort retreat strategy to determine the associated costs.	Yes	
S-PDC3	Relocate Swansea North to Swansea South - involves abandoning North section of peninsula and building further South on higher ground	Multiple	Swansea	Yes	It is recommended that this option undergoes further analysis as a last resort retreat strategy to determine the associated costs.	Yes	
S-PDC4	Create "Swansea Square" CBD design	Multiple	Swansea CBD	Yes	In principle support. It is recommended that this option undergoes further analysis to determine the associated cost/ benefit. Additional analysis is required when considering the design, sequencing and timing of raise and fill scenarios.	Yes	Consider to combine with Option S-OGW3
S-PDC5	Assess business case for adaptation options of Swansea Caravan Park including raise or relocate	Multiple	Swansea	Yes	It is recommended that this option undergoes further analysis to determine the associated cost, benefits and timing.	Yes	Council business unit interested in business case; timing etc
S-PDC6	Develop an evacuation strategy for Swansea and Surrounds including commercial and residential areas	Flooding, and East Coast Lows	All	Yes	Liaise with Council, SES and other stakeholders regarding implementation, including CATs (community action teams)	Yes	BAU

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Planning and Development Controls							
S-PDC7	Set aside land for inundation	Multiple	All	Yes	In principle support, has been used in other areas. Adaptable over time when sequenced with other options. It is recommended that this option undergoes further analysis to determine the associated cost/benefit. Additional consideration is required regarding the selection/ prioritisation of land (as per hazard or social value).	Yes	
S-PDC8	Review Zoning - consider less intensification	Multiple	All	Yes	In principle support. Requires cost benefit analysis. Additional consideration is required regarding the selection/prioritisation of land (as per hazard or social value). The benefits here are realised by achieving reduced risk to life with a trade off on the opportune cost of economic gain	Yes	whilst this is planning, it is still the precursor to other options that will have an financial impost; discuss
S-PDC9	Review Zoning - consider greater intensification	Multiple	All	Yes	In principle support. Requires cost benefit analysis. Additional consideration is required regarding the selection/prioritisation of land (within Swansea area or nearby).	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Maintenance, Monitoring and reporting							
S-MMR1	Clean stormwater channels and drains of sludge, trees and other vegetation	Nil	All	Yes	Included in current base case however requires reinforcement/priotisation within ongoing capital planning/budgeting.	Yes	Part of BAU; However, need to ensure ongoing monitoring and updating for best practice.
S-MMR2	Monitor and report on SLR state, impacts and options	Multiple	All	Yes	Commenced and ongoing, explore additional avenues for reporting.	Yes	
Piloting, Research and Innovation							
S-RRI1	Raise and fill the Black Neds Bay wetland	Tidal inundation, East Coast Lows and Groundwater	Blackneds Bay/ Wetlands	Yes	Some international case studies are available though feasibility is still relatively unknown. Further investigation is required - potential for pilot project/s.	Yes	Consider to combine S-RR2 and also with Pelican/Blacksmiths
S-RRI2	Raise and fill other wetland areas TBC	Tidal inundation, East Coast Lows and Groundwater	Wetlands	Yes	Some international case studies are available though feasibility is still relatively unknown. Further investigation is required - potential for pilot project/s.	Yes	Consider to combine S-RR1 and also with Pelican/Blacksmiths
S-RRI3	Narrow the entrance of the channel - ie: the breakwalls at the entrance	Tidal inundation, flooding, and East Coast Lows	Channel Control	Yes	Potentially significant environmental, economic and social impacts associated with this option.	Yes	Consider as a combined channel management/control - cluster
S-RRI4	Review works/research/ learnings of other locations to consider their suitability and applications in our local setting.	Multiple	All	Yes	This is commenced and ongoing.	Yes	

ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Advocacy and Industry Engagement							
S-AIE1	Raise Pacific Highway as barrier between Blackneds Bay and CBD	Multiple	Swansea/ Swansea CBD	Yes	It is recommended that this option undergoes further analysis to determine the associated cost/benefit. Additional analysis is required when considering the sequencing of raise and fill scenarios	Yes	Requires Further examination
S-AIE2	Raise utilities as required - electricity, gas, water, comms.	Multiple	All	Yes	Further information and engagement is required from utility providers regarding the need, feasibility and timing of proposed raising (or alternate adaptation pathway)	Yes	Requires Further examination
S-AIE3	Coordinate all levels of Gov for consistency and uniformity of coastal resources	Multiple	All	Yes	Local Adaptation Plan requires input from all levels of government to be feasible. Reinforced by Coastal Management Reforms, April 2018.	Yes	Whilst not for MCA/ CBA - Consider in LAP - Part of BaU
S-AIE4	Show genuine care about the natural environment	Multiple	All	Yes	This is currently being undertaken. It is acknowledged that this consultation effort (inc. gov and non-gov agencies) must be consistent through time and information updated as dictated by global best practice.	Yes	Whilst not for MCA/ CBA - Consider in LAP - Part of BaU

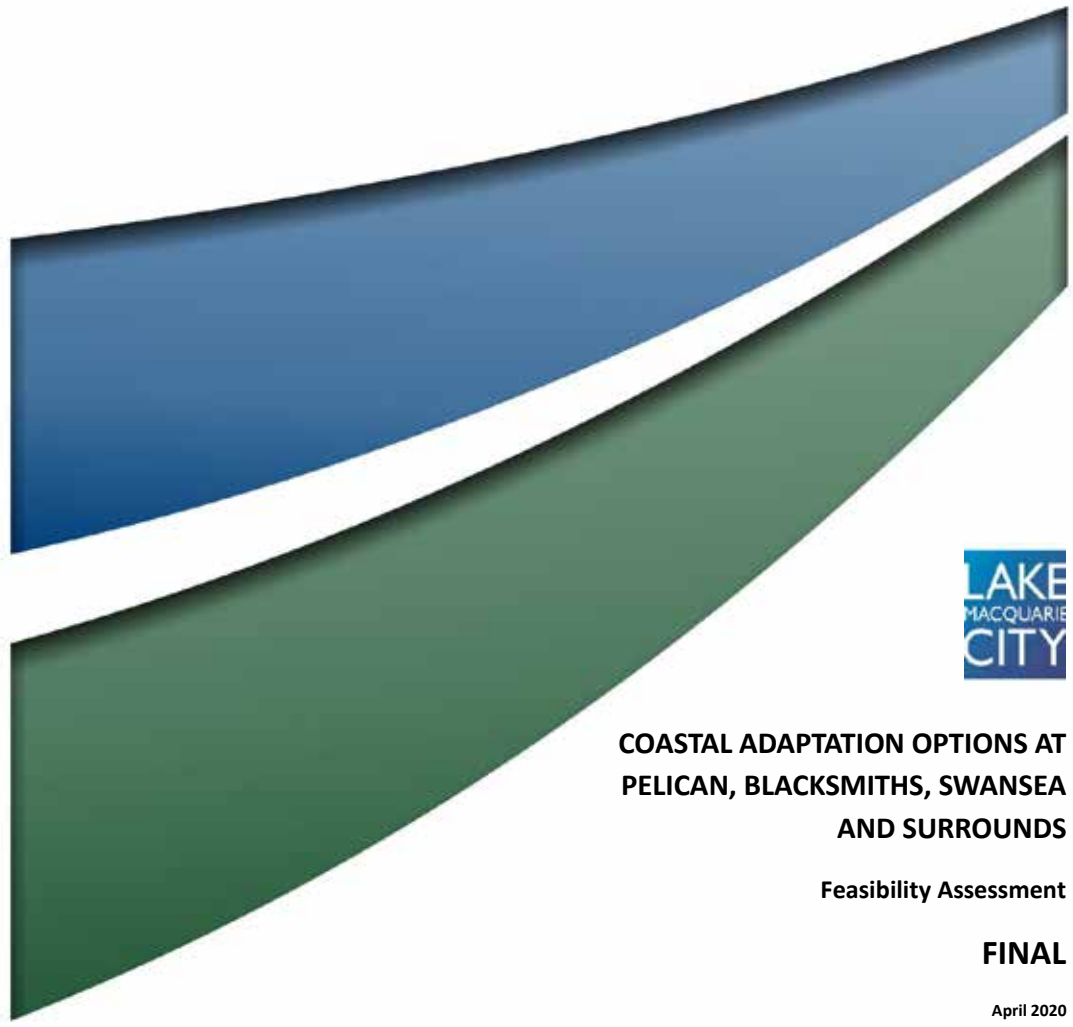
ID/Call #	Option	Hazard/s identified by council/ community	Location	Meets Working Group Criteria (Y, N, ?)	Assessment Response Note/s	Progresses to further assessment (Y, N)	Any further comment (Total Progressed, N = 45)
Community Engagement							
S-CE1	Develop early notification options to those properties expected to be affected by a storm/tidal event	Floods and East Coast Lows	All	Yes	Currently available for residents to subscribe to. Further analysis is required as to how the existing Early Warning Network can be improved based upon changing technologies.	Yes	Whilst not for MCA/ CBA - Consider in LAP - Part of BaUand ongoing community engagement and capacity building.
S-CE2	Flood Preparedness - provide information and genuine consultation and engagement for residents/community/ businesses - to build resilience, understanding and navigate flooding hazards. Provide more information and what to do to help during flooding	Multiple	All	Yes	This is currently being undertaken It is acknowledged that this consultation effort (inc. gov and non-gov agencies) must be consistent through time and information updated as dictated by global best practice.	Yes	
S-CE3	Use experts in engineering and consultation to communicate with community	Multiple	All	Yes		Yes	
S-CE4	Provide education of the risks posed should be mandatory which then allows for community feedback on what measures should be taken to mitigate the risks.	Multiple	All	Yes		Yes	
S-CE5	Engage younger people	Multiple	All	Yes	This is currently a challenge which is likely overcome through greater participation of other agencies (e.g. Education Sector)	Yes	

APPENDIX 7

Summary of multi-criteria analysis and cost-benefit analysis

Appendix 7.1: Summary of multi-criteria analysis

umwelt
Environmental & Social Consultants



LAKE MACQUARIE CITY

COASTAL ADAPTATION OPTIONS AT PELICAN, BLACKSMITHS, SWANSEA AND SURROUNDS

Feasibility Assessment

FINAL

April 2020

Table 3.10 Consolidated criteria used in the Feasibility Assessment MCA

Criteria	Notes/comments
Governance and statutory compliance criteria	
MG1 This option is consistent with the objects of the Coastal Management Act	Thirteen objects (as shown in **Table 3.2**); also, separate management objectives for the coastal management areas
MG2 This option is consistent with relevant statutory and policy requirements and has a recognised approval pathway	This will include EP&A Act, FM Act, BC Act, CLM Act, Local Government Act Suggest moving 'recognised approval pathway' into this criterion, as it flows from being consistent with the relevant legislation
MG3 Council and other government bodies have suitable capacity and capability to implement this option	This relates to skills, knowledge, willingness to implement – so Council can manage and deliver the option
MG4 This option can be implemented without complex governance and partnership arrangements	This complements the above. There are higher long-term implementation risks if multiple complex partnership arrangements are necessary
Environment criteria	
E1 This option is consistent with principles of ecologically sustainable development **Some principles describe decision making processes and other describe the outcome of the decision**	Principles of ESD: • Precautionary principle – if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Decision making processes should effectively integrate both long and short term economic, environmental, social and equity considerations • Intergenerational equity • Conservation of biodiversity and ecological integrity (essential ecological processes and life support systems) • Improved economic valuation (pricing and incentive measures), including environmental factors • Principle of integration (of economic and environmental factors in decision making), maintain competitiveness at relevant scales • Principle of sustainable use (also in CLM Act) – development that improves the total quality of life, now and in the future • Decisions and actions should provide for broad community involvement on issues which affect them
E2 This option would provide a natural buffer from coastal hazards	This is consistent with the management objective is for coastal vulnerability areas in the CM Act. i.e. natural defences first and built defences only when natural defences are not sufficient to provide protection
E3 This option does not transfer adverse environmental outcomes to other locations or parts of the local environment. Specifically, it does not transfer adverse environmental outcomes to coastal wetlands, littoral rainforests or other sensitive environmental areas such as sea grass meadows.	Picks up specific protections for coastal wetlands in the management objectives of the CM Act

Criteria	Notes/comments
E4 This option does not create adverse environmental outcomes for the Lake Macquarie estuary or foreshores	Some options have significant implications for the tidal circulation or flooding dynamics of Lake Macquarie or could impact on water quality
E5 The environmental impacts of this option are acceptable to the community	Local residents (property owners or renters) believe that any impacts on environmental quality are acceptable, now and in the future
Social, cultural and community criteria	
S1 This option maintains the presence and amenity of beaches and foreshores	Including public accessibility and scenic amenity Beach and foreshore access, use and enjoyment are key elements of the lifestyle of these three suburbs
S2 This option is effective at protecting public health and safety from coastal hazards	Relates to community infrastructure such as stormwater and sewage systems, but also to the safety of foreshores such as those with high current velocities; may also be relevant if an option triggers rapid shoaling or could expose rock
S3 This option maintains or improves physical connectivity and social cohesion within Swansea, Blacksmiths and Pelican communities	This means that people can move around the suburbs without new constraints to access places that are important in their lives, such as shops, doctors, playing fields, walking tracks, clubs/restaurants
S4 This option is acceptable to the people of Swansea, Blacksmiths and Pelican	Local acceptability on social and cultural grounds
S5 This option is acceptable to the broader Lake Macquarie community	This is a broader social value question. Would the options increase social values for the broader community?
S6 This option protects Aboriginal and historic heritage places and values in the three suburbs	The lake entrance area has high Aboriginal heritage value and is also one of the earliest settled parts of Lake Macquarie
Technical practicality and certainty criteria	
T1 This option is feasible in engineering terms	This will apply principally to coastal protection structures, but also filling, decontamination - activities where engineering expertise is essential
T2 This option can address the identified issues to achieve the objective, now and over the long term	The option is robust in the context of changes to hazards over time
T3 This option is adaptive and can transition to alternative approaches	Transition requires both technically feasible sequences and appropriate trigger values
T4 This option is part of a hierarchy or framework of related controls that should be implemented together to be effective	Part of a cluster of responses that would support each other
Economic/Financial	
F1 Indicative capital and maintenance costs to implement this option are likely to be fundable within council's budget	Very high capital or maintenance costs are likely to be not feasible, because of limits on the funds that Council can raise or allocate to managing the coastal risks affecting these areas. Threshold for unacceptable costs has not currently been tested
F2 The cost to implement this option is acceptable to the people of Lake Macquarie	This is a question about perceived value for money, including consideration of opportunity costs. If council invests in adapting the suburbs on the eastern side of the lake to tidal inundation and channel migration hazards, will the broader community think this is a worthwhile investment?

3.7.7 Options included in the MCA analysis

Following discussion and review with the Steering Committee about potential options to be included in the MCA, a total of 31 options was evaluated in the MCA. These options are summarised below. **Table 3.11** provides a brief description of what is intended with each of the potential responses. Some of these options have been identified and evaluated in previous coastal zone management plans and flood risk management plans. Where available, more information is provided about known issues affecting the feasibility of the response in this local context (in the right hand column).

Table 3.11 Management responses included in MCA analysis

ID	Management response included in MCA	Summary of what is intended
Coastal protection options		
CP1	New protection works on the Pelican foreshore to Naru Point - Note that options for this foreshore are being addressed through a site-specific process	These protection works will include a rock structure extending to the depth of scour. Designed to mitigate current and future risks and recognise local and system wide effects of coastal processes. Design to be integrated with boat ramp and other safe access to the water.
CP2	Foreshore protection works for environmental areas such as Coon Island	This would require construction of rock, earth mound or other revetment structures on the natural foreshores of Coon Island and potentially other environmental land, to minimise inundation risks. For preference, the design would maintain some tidal circulation and facilitate gradual adaptation of the wetland and heritage areas to higher water levels.
CP3	Active maintenance and adjustments to training walls	Active maintenance continues current practice of structural maintenance to maintain effectiveness (protect from waves and overtopping, direct currents appropriately), protect public safety. Adjustments to training walls include broader scale intervention to alter tidal response of the channel and lake.
CP4	Foreshore/nearshore protection works to protect Salts Bay and Black Neds Bay from wave energy	Multiple groynes are already in Salts Bay to protect wetland (saltmarsh and mangrove) from shoreline retreat. This action is about additional works (likely a seawall) to provide further protection to prevent storm surge overtopping into Black Neds Bay residential areas and the Swansea CBD.
CP5	Investigate defensive structures (sea wall) north of Blacksmiths surf club	Strengthen protection of residential areas from wave overtopping by constructing protection works (such as a rock wall) with a higher top level than the existing dunes ('natural defences'). Note this sea wall option is not included in the engineering feasibility assessment in **Appendix 7**. Hazards and appropriate protection works in this location will be further assessed during the preparation of the new Lake Macquarie Coastal Management Program.
CP6	Channel lock or barrage at the entrance	This involves construction of a large structure across the entrance of Lake Macquarie (at a suitable site seaward of the Bridge). The intent is to control tidal flows into the lake, particularly at high water levels.

Appendix 7.2: Summary of CBA option graphics

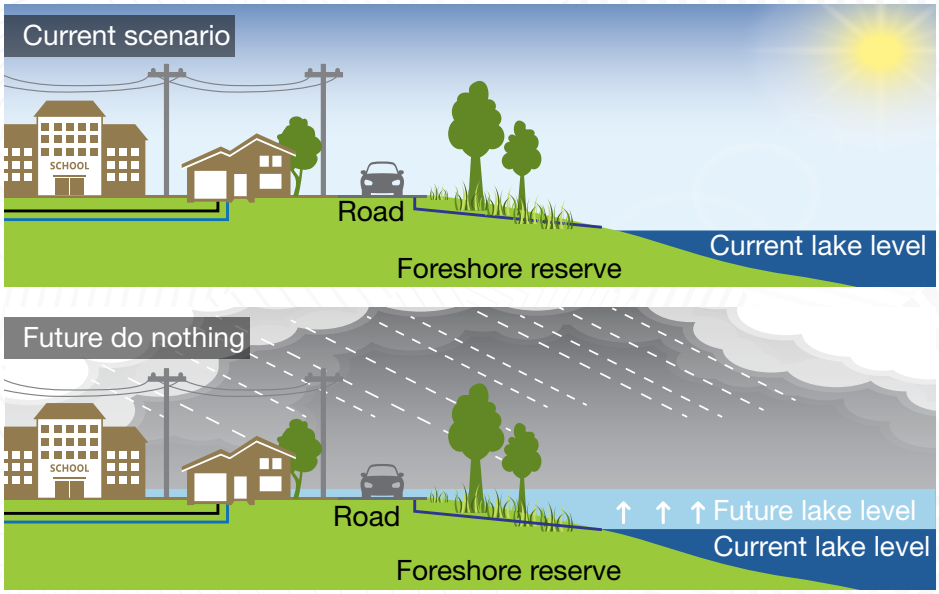
CBA option graphics and description provided to the broader Lake Macquarie community by Council and the LAP working group

Note: The location, scope and assumptions for options tested in the CBA varied in relation to the majority of options assessed. For full details of options tested in the CBA please refer to the full report available on the Shape Lake Mac Adapting Swansea LAP site.

Raise and Fill Land and Built Assets

This set of illustrations shows adaptation options to raise and fill educational land, residential land, infrastructure (roads), and other infrastructure (including sewer, water, power and stormwater drainage lines). It also includes the raise and fill of public recreational land, such as foreshores and playing fields, to maintain access. This diagram does not represent a specific location, but shows the overall raise and fill concept.

10.1 Raise and Fill Land and Built Assets illustration

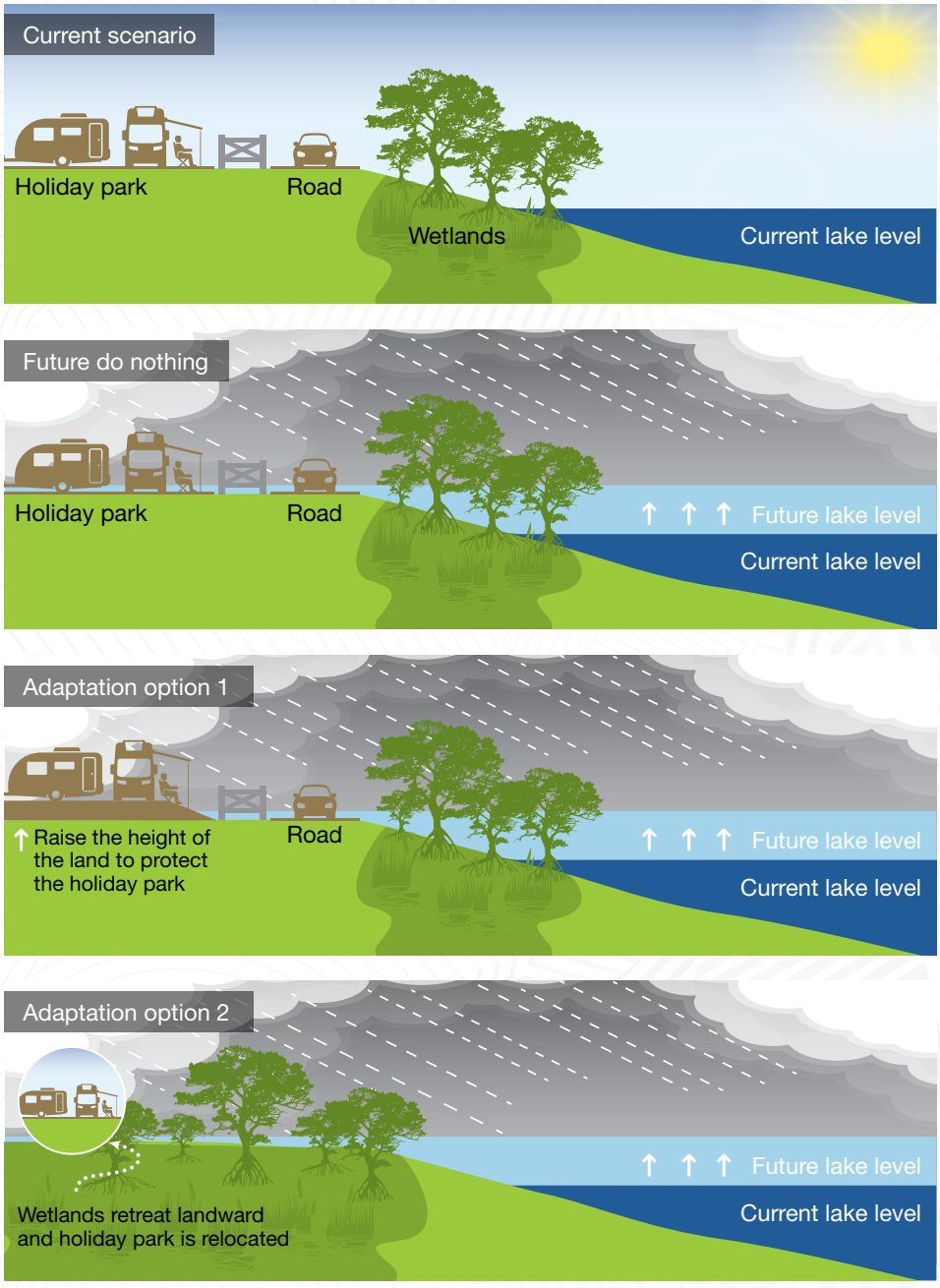


Data source: Lake Macquarie City Council 2020, Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds, https://shape.lakemac.com.au/37415/widgets/210625/documents/167956

Holiday park and wetlands

This set of illustrations show multiple possibilities to adapt both the Swansea Holiday Park and wetland areas in the study area. For example, at Coon Island, if both the holiday park and wetlands are inundated, one adaptation option would be to raise the holiday park. The wetlands would be lost and offset with the development of protected wetland reserves elsewhere around the lake. Alternatively, another adaptation option is to relocate the holiday park elsewhere to allow the wetlands to move landward. The consideration of these wetland options applies to other locations in the study area.

10.2 Holiday park and wetlands illustration

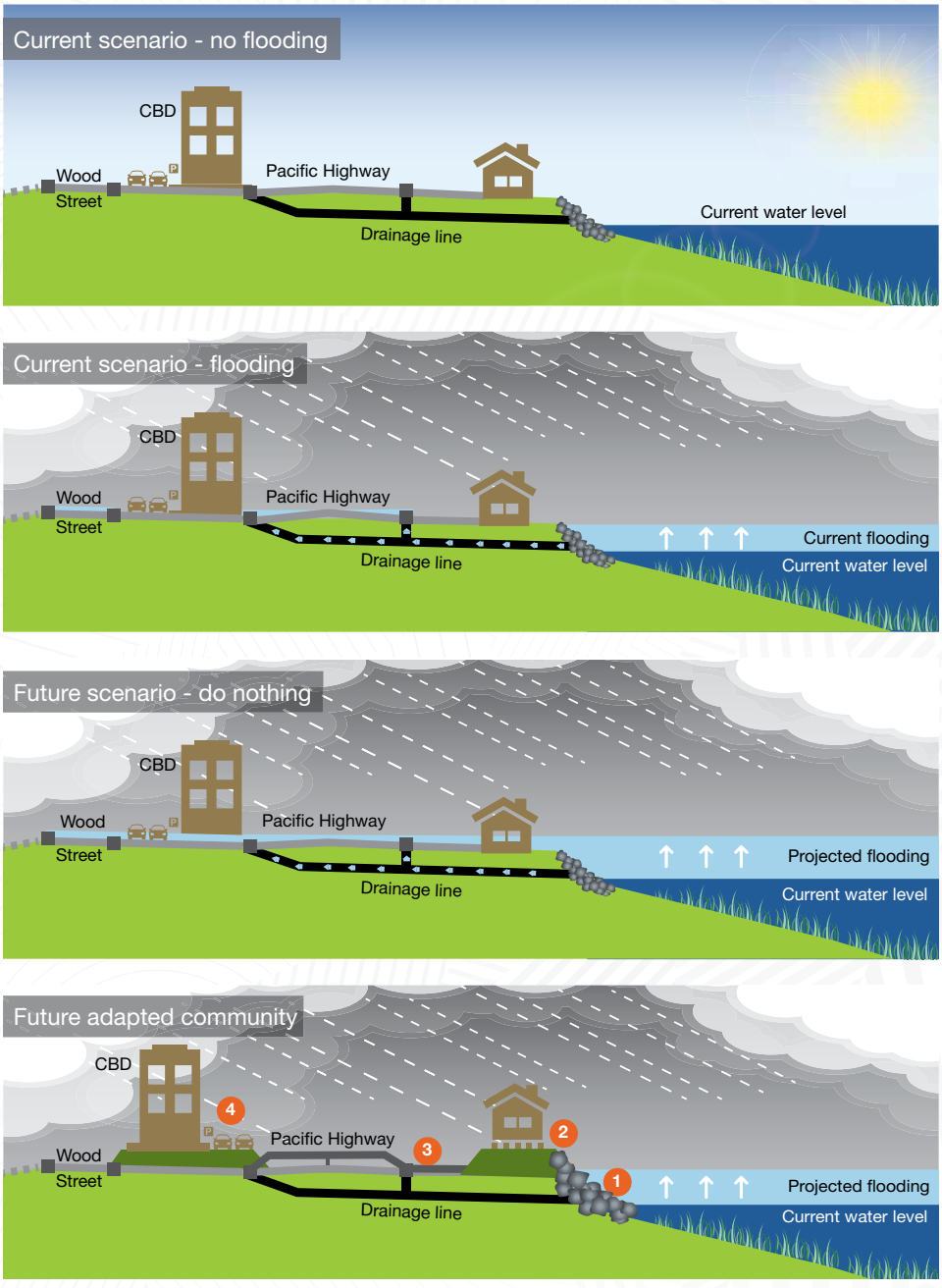


Data source: Lake Macquarie City Council 2020, Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds, https://shape.lakemac.com.au/37415/widgets/210625/documents/167956

Channel and Foreshore protection works

This series of options considers the protection of Swansea's economic centre (CBD). It is a four-staged process to raise the CBD over time. At present, under normal conditions no flooding occurs. However, during high tide, or high intensity storms, flooding does take place across sections of the Pacific Highway, the CBD, and along Wood Street. As water levels rise and storm intensity and duration increase, flooding will become more severe eventually inundating the CBD and Pacific Highway, as shown. The first stage of the suite of options is to raise the exiting revetments along Black Neds Bay (1), followed by the raise and fill of residential land of properties adjacent to the Bay and some sections of recreational land (2). The major arterial roads connecting to the Pacific Highway will then need to be raised (3). Finally, Swansea CBD and car park will then be prepared to be raised and filled (4).

10.3 Channel and Foreshore protection works illustrations

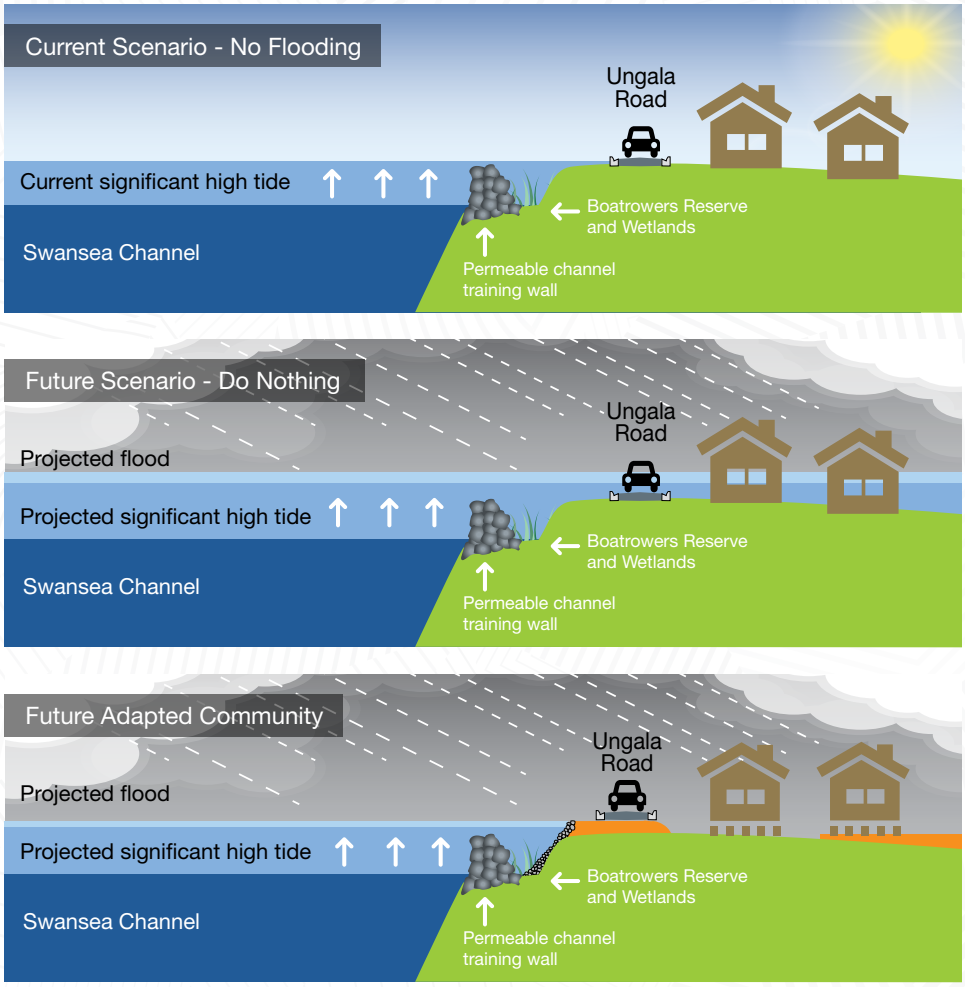


Data source: Lake Macquarie City Council 2020, Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds, https://shape.lakemac.com.au/37415/widgets/210625/documents/167956

Raise and fill of Ungala Road

This illustration series considers specifically raising Ungala Road and varies from the raise and fill of other infrastructure. It will also be a staged process with sections of Ungala Road that currently experience inundation raised first. The boat ramp, car park and residential land would also need to be raised to prevent water pooling.

10.4 Raise and fill of Ungala Road illustrations



Data source: Lake Macquarie City Council 2020, Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds, https://shape.lakemac.com.au/37415/widgets/210625/documents/167956

Appendix 7.3: Cost Benefit and Distribution Analysis of Adaptation Planning Options – Executive Summary

Executive Summary

The task

Salients Pty Ltd, Umwelt Environmental and Social Consultants and The Centre for International Economics (The CIE) have been commissioned by Lake Macquarie City Council (the Council) in collaboration with the communities of Pelican, Blacksmiths and Swansea to evaluate adaptation pathways to coast and estuary change. This report covers the Cost Benefit Analysis (CBA) undertaken by the CIE to evaluate a subset of options to adapt to future inundation risks arising from the effects of catchment and/or tidal inundation, in Pelican, Blacksmiths, Swansea and surrounds (the case study area). The study evaluates the costs and benefits of alternative adaptation options to dynamic coast/estuary processes that are expected to increase the inundation risks faced by low lying communities in the case study area. The options proposed by the community and eventually tested are discussed below.

Options considered

The adaptation planning process for the case study area is led by a Steering Committee and supporting working groups which includes council, local community, and public authority representatives. The Pelican, Blacksmiths, Swansea, and surrounding areas working groups (a combined working group derived from two previously separate working groups) developed a suite of potential management options which were shared with the broader community via a community information evening and workshop in August 2019. On the basis of community engagement, the working group consolidated a list of 112 community options for further consideration in a subsequent formal three-stage evaluation process:[1]

1 **feasibility** — identify options that are practical, effective and align with legislation and policy

2 **viability** — economic evaluation using cost benefit assessment (this report)

3 **acceptability** — to the community in terms of capacity to deliver the community's objectives, funding and cost implications and timeliness.

1 Umwelt Pty Limited 2020, *Coastal Adaptation Options at Pelican, Blacksmiths, Swansea and Surrounds: Feasibility Assessment*. Report prepared with Salients Pty Limited, for Lake Macquarie City Council.

The technical feasibility of adaptation options was analysed in a Multicriteria Assessment (MCA) which identified:[2]

- options that were considered suitable i.e.: feasible, viable, and acceptable (such as tidal gates) – the working group recommended that these progress directly to be considered for incorporating into the Local Adaptation Plan (LAP)[3] or Council's Coastal Management Program without needing to be assessed for economic feasibility by a CBA
- options that were not feasible, viable and/or acceptable (for reasons outlined in the MCA report), and
- 13 options that were considered appropriate for further analysis with respect to economic feasibility by means of a CBA.

These 13 options are summarised in the following categories:

1 Options to Raise and Fill Land and Built Assets
2 Swansea Holiday Park and Wetland/Environmental Options
3 Channel and Foreshore Protection Works
4 Staged raising of Ungala Road, including the concurrent raising of the boat ramp car park and raising of residential land to avoid water pooling and inundation of the road and adjoining residential areas.

Before the CBA commenced, Council and the Steering Committee further developed the concept designs and parameters for these options, to which the majority of the steering committee agreed.[4] Graphics illustrating each option and a brief description were provided to the broader community (Appendix A). Further information is provided in the Lake Macquarie City Council document *Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds*.[5] These designs, parameters and assumptions have continued to be reviewed as the CBA has been prepared. This resulted in refinement of the options to more closely align a conceptual design level, that can be costed and practically implemented. Refer to Table i for a broad overview of the options evaluated in the CBA.

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2 The methodology for community and technical review and the rational for narrowing down options is detailed in Umwelt Pty Limited 2020, *Coastal Adaptation Options at Pelican, Blacksmiths, Swansea and Surrounds: Feasibility Assessment*. Report prepared with Salients Pty Limited, for Lake Macquarie City Council, https://shape.lakemac.com.au/37415/widgets/210625/documents/167565

3 We note acceptability will continue to be considered through all parts of the LAP process.

4 References to the Steering Committee here after, denotes the majority of the Steering Committee.

5 Lake Macquarie City Council 2020, *Options guide for the cost benefit analysis: Pelican, Blacksmiths, Swansea and Surrounds*, https://shape.lakemac.com.au/37415/widgets/210625/documents/167956

i Options evaluated in the cost-benefit analysis (CBA)

Option	Description	Comments	Refined design parameters
Options to raise and fill land and built assets			
AC1	Raise and fill residential areas (house sites and yards)	A high-risk inundation area in Pelican was identified during the Local Adaptation Plan (LAP) development by the joint Council and Community Working Group. We understand this area is generally bounded by Soldiers Road, Lorna Street and Lakeview Parade.	▪ Mosaic raise and fill trigger.
AC2	Raise transport infrastructure (over and above gradual raising of roads through maintenance)	Local roads to be raised include the length of road near the intersection of Lakeview Parade and Soldiers Road Pelican. This will need to be done alongside raising residential land to maintain serviceability. It will also include local roads connecting to the Pacific Highway. This option is independent of any raise/fill of any residential properties.	▪ Raising roads in the Pelican area is intended to support maintaining serviceability of properties. However, residential land raising (option AC1) is not economically viable. Therefore, raising roads would not be adopted at this stage. The timing of any raising of the Pacific Highway by RMS is also unknown. ▪ Given this, we have modelled an alternative option of gradually raising roads (from the most to the least flood prone) over a specified time.
AC3	Raise other infrastructure (power, water, sewer, stormwater, telecommunications)	This option would reduce the disruption to properties if the assets are inundated. In practice, this option would need to be considered alongside the road raising option (AC2) given that infrastructure assets may be located within/alongside the roads.	▪ Many of these assets run alongside the road corridor. The sequencing of asset upgrades has been linked to the road raisings.
AC4	Raise and fill education land (schools)	This option is to reduce school disruption associated with inundation events. Three schools have been identified in the case study area for potential raise and fill: ▪ St Patricks ▪ Swansea Public School, and ▪ Pelican Flat Public School.	▪ A mosaic raise and fill modelling approach has been used, such that raising is triggered when the present-day property ground level is below the chosen trigger height. The school site and associated buildings are subsequently raised to the chosen raise height.
AC5	Raise and fill public recreation land such as foreshore reserves and playing fields	This option is to maintain access to recreational activities – including active and passive recreation: sporting facilities and public open space.	▪ The recreational land is assumed be raised in each year from 2021 based on the most inundation prone to the least inundation prone land. Recreational land would be raised to the 1% AEP event at 2050 height.
AC7	Raise and fill commercial land in the Central Business District (CBD)	Potential raise and fill of the commercial land in the CBD	▪ Mosaic raise and fill trigger on existing sites.

Option	Description	Comments	Refined design parameters
Swansea Holiday Park and Wetland/Environmental Options			
AC6	Raise and fill Swansea Holiday Park	Raise and fill the Swansea Holiday Park.	▪ Raise and fill based on inundation trigger heights
AC6B	Relocate Swansea Holiday Park	Maintain access to the foreshore, or allow adjoining wetlands and lake to encroach onto land currently occupied by Swansea Holiday Park, while relocating the Swansea Holiday Park to one of the following locations: ▪ Belmont Bayview Park, or ▪ Greenfield site adjacent to Belmont golf course	▪ Relocation at a specified time to occur in 2030
RA4	Allow wetlands to move landward on 'environmental land' around Pelican Inlet and other suitable areas	Locations for consideration: ▪ Coon Island ▪ Galgabba Point ▪ Pelican Inlet, and ▪ Black Neds Bay.	▪ Wetlands options not evaluated in full. There is uncertainty regarding how quickly wetlands are established with temporary inundation.
RA5	Allow wetlands to move landward into coastal use area, with land acquisition		
RA6	Offset losses of wetlands with wetland reservation elsewhere around the lake	Offsets are unlikely to be like for like, as the channel area is different to most other wetlands around the lake.	▪ Wetlands options not evaluated in full. There is uncertainty regarding how quickly wetlands are established with temporary inundation.
Channel and Foreshore Protection Works			
CP4	Inundation protection works (or a levee) inside Black Ned's Bay		▪ Construction of a vertical 1.7m AHD concrete wall along the western shore of Black Neds Bay.
Staged raising of Ungala Road			
CP8A/CP 14	Staged Raising of Ungala Road, first near the boat ramp	Stage raising would also need to coincide with stormwater drainage, tidal gates and/or residential raise/fill, similar to option (AC1), to avoid water pooling when Ungala Road is raised.	▪ The option description document notes this option is proposed in a sequence with raise and fill the Mankilli St area (part of AC1) and tidal gates on Ungala Road (CP8B). Both raise/fill of residential properties in Mankilli St and the tidal gates were not considered. Raise/fill triggers presented for illustrative purposes.

Source: Umwelt Pty Limited 2020, *Coastal Adaptation Options at Pelican, Blacksmiths, Swansea and Surrounds: Feasibility Assessment*. Report prepared with Salients Pty Limited, for Lake Macquarie City Council, https://shape.lakemac.com.au/37415/widgets/210625/documents/167565, and subsequent input from the Steering Committee.

For the purposes of this analysis, we have treated the options as discrete, although we recognise that there are interactions between them. For example, if inundation causes local road closures then this would reduce access to schools, the CBD and public recreation spaces. This would need to be considered further following a decision regarding which options to progress in the LAP.

Inundation risk

Salients, in consultation with the University of Queensland and Flood Focus Consulting undertook a Probabilistic Hazards Assessment (PHA)[4] to model the probability of future water level exceedance in the case study area and these results (or outputs) have been adopted for use in this CBA. The full methodology and results are detailed in Salients et al. 2020.[6] Salients et al. 2020 note that calculated water levels include the combined effect of catchment flooding and tidal inundation. As such, this report uses the broader term "inundation" to encompass the combined risk of these effects.

We note the recent (approximately 8 years of water level data) measured high-water levels at the water level gauges within Swansea Channel (downstream of Swansea Bridge) are somewhat higher than during previous measurement periods.[7] It is unclear at this stage whether these more recently measured high water levels are indicative of an acceleration in measured rates of global sea level rise (SLR), or whether they are representative of the inherent natural variability of local mean sea level in response to various drivers that influence peak records at the Swansea water level gauge (for example variability around El Niño/La Niña conditions, catchment flood and coastal storm frequency, and other conditions that raise local water levels).

Historically, water level data, from the Fort Denison gauge in Sydney (the most applicable long-term data available), show that there are medium term periods (years to decades) of both higher and lower water levels that occur relative to mean sea level and historic rates of measured SLR. That is, there are peaks and troughs in high-water levels that are irregularly spaced and unable to be accurately forecast. There is currently insufficient time-series climatic data available to test the extent to which recent observed high-water levels at Swansea are part of this natural variability or reflect a more permanent 'structural shift' compared to the historical data series. The known gradual increase in the Lake Macquarie tide range due to the increasing hydraulic efficiency of the Swansea channel over time also has an impact on changing water levels measured at the Swansea gauge.

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6 Salients et al. 2020, *Probabilistic Hazard Assessment to Support Local Adaptation Planning for Pelican, Blacksmiths and Swansea – Final*

7 Hanslow, D (2019). Water level trends in NSW coastal lakes by use of exceedance probability analysis, *Australasian Coasts and Ports 2019 Conference: Future directions from 40 [degrees] S and beyond*, Hobart, 10-13 September 2019, https://search.informit.com.au/documentSummary;dn=799043410816316;res=IELENG

Following discussion with the Steering Committee, we present an alternate scenario for options AC1 (raise and fill residential areas (house sites and yards)), AC7 (raise and fill commercial land in the CBD) and CP4 (inundation protection works), in the form of a sensitivity test, where inundation levels are assumed to be 0.2m AHD higher than those predicted by the statistical PHA model. This is to provide additional information to understand how the results of the CBA would change if the inundation risks were higher than modelled.

CBA results

The key economic indicators of net benefits and benefit cost ratio (BCR) are presented for each option in Table ii. The CBA results show that the selected options (without sensitivity analysis applied) generate net costs (i.e. the costs outweigh the benefits) and all options have BCRs less than 1. This is because the inundation risks are expected to be relatively low in the short term and most options require significant structural intervention.

ii Net benefits and BCRs by option

Option	Total cost	Total benefit	Net benefit	Benefit cost ratio
	$, (PV)	$, (PV)	$, (PV)	BCR
AC1	443 439	196 202	-247 237	0.44
AC2	35 000 000	3 460 000	-31 540 000	0.1
AC3	9 500 000	1 700 000	-7 800 000	0.18
AC4	2 969 611	24 701	-2 944 909	0.01
AC5	28 000 000	9 600 000	- 18 400 000	0.34
AC6	5 582 410	200 881	-5 381 529	0.04
AC6B	3 797 227	2 730 321	-1 066 907	0.72
AC7	381 721	17 781	-363 940	0.05
CP4	1 425 278	34 689	-1 390 590	0.02
CP8A/CP14	150 000	not quantified		
RA4, 5, 6	Not quantified due to lack of information			

Note: Present value are based on a 30 year cashflow stream and a 7 per cent real discount rate.
Source: CIE.

Options related to allowing the landward movement of wetlands were considered qualitatively due to limitations on information and requirements.

Table iii shows the net benefits and BCRs for the +0.2m AHD water height sensitivities.

iii Net benefits and BCRs for water height sensitivities

Option	Total cost	Total benefit	Net benefit	Benefit cost ratio
	$, (PV)	$, (PV)	$, (PV)	BCR
AC1	607 914	941 176	333 262	1.55
AC7	3 889 146	456 629	-3 432 517	0.12
CP4	1 425 278	293 068	-1 132 210	0.21

Note: Present value are based on a 30 year cashflow stream and a 7 per cent real discount rate.

Source: CIE.

Table iii shows the CBA results are highly impacted by the underlying modelled inundation risk. The net benefit for Option AC1 becomes positive, along with a BCR greater than 1. However, the other two options still deliver a net cost for society.

Findings and recommendations

The central CBA results (without sensitivities) show that most of the options requiring significant structural intervention are not cost effective to implement now. That is, the current levels of risks and damage are not sufficiently large to warrant taking the identified action *immediately* from an economic assessment standpoint.

This CBA is one of a number of tools used to assess a limited number of options developed from the MCA, and it is highlighted that there are other options, drivers and considerations for discussion in the upcoming LAP.

Over the longer term, the modelling demonstrates that the level of risk and damage increases substantially after 2050. This may reflect a 'tipping point' has been reached such that the inundation levels for the frequent events become higher than existing floor levels. The projects could become viable at a future point in time as the inundation risks increase (due to SLR), therefore, there is value in delaying the decisions regarding the options to implement. This is also important where new technologies become available to manage the different risks.

While the findings above do not support the immediate implementation of the options, it is important that this is not interpreted as encouraging Council to 'do nothing'. Rather, the results imply that there is time to conduct further robust planning to ensure that the future actions provide the best 'value for money' for the community.

Given this, we recommend the following actions for Council's consideration.

Continued monitoring of inundation risks

As noted earlier, the conclusions of the CBA reflect the inundation risks modelled by Salients, in consultation with the University of Queensland and Flood Focus Consulting. The inundation modelling utilises statistical modelling based on recorded history. While

this modelling was based on the best information currently available, these risks are not known with certainty. There is uncertainty regarding how climate change could impact on the inundation risks, including in the short to medium term.

Given this, it is important that there is ongoing monitoring of the inundation levels to understand whether any changes in the risks would alter the results of the CBA. Sensitivity analysis conducted for some of the options provides a guide on how changes in inundation risks can change the CBA results and conclusions.[8] If new information changes the risks in line with the sensitivity analysis, then there may be merit in implementing (in the short term) some of the options considered.

Continued planning of actions

There is significant value in having time to undertake robust planning in advance of a 'crisis'. Therefore, given that the inundation risks are not imminent Council should take this opportunity to continue developing strategies to manage inundation risks.

Some actions that could be undertaken include:

- The CBA was based on the available elevation data (e.g. ground levels, property floor levels, roads, sewer main depths). Further data collection could be undertaken to help refine the analysis at a later stage. If there are significant changes to the elevation data, then additional analysis should be undertaken to test the extent of changes in inundation risk. If there are significant changes to inundation risks then additional economic analysis should be conducted to evaluate the options.
- Gathering additional information on the costs of the different actions should also be undertaken. The CBA was based on the best available information within the scope of the project. Further site-specific investigations may change some of the cost assumptions adopted in the CBA.
- Additional information is required to understand the extent of use of the different recreation areas.
- In regard to the wetlands, specific studies could also be undertaken to understand the value that the community places in expanding the wetlands. It would also be useful to gain further scientific information on the frequency of inundation required for wetlands to establish and how quickly wetlands could establish.
- Investigation of other actions should also be undertaken to understand whether there are 'better' actions than those considered in the CBA. This may arise where, for example, there are technological advancements which reduce the costs of managing inundation risks.

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8 This included options AC1 (raise and fill residential areas (house sites and yards)), AC7 (raise and fill commercial land in the CBD) and CP4 (storm surge protection works). Sensitivity analysis tested included where inundation levels are 0.2m AHD higher than those predicted by the statistical model.

- For all options, Council should consider when approvals should be sought from relevant authorities, and agreements in principle from property owners affected (including where access to a property is required for construction works).

Interlinkages between the different actions

There are significant interlinkages between property damage and damage to other assets (e.g. roads, electricity, water etc). For example, raising roads would be dependent on the raising of residential properties (or commercial properties). Likewise, any upgrading on sewer/water mains should be interlinked with any road raising.

In the options modelled, the property raisings are not triggered in the immediate future, reflecting the relatively low levels of risk currently faced by the properties. If the property raisings aren't triggered then raising roads could then have detrimental impacts on some locations (e.g. by causing pooling of water). Given this, it would be prudent to develop risk management strategies on a 'region by region' basis, covering all the assets. This will involve first understanding the inundation risks to each of the assets and then developing strategies that result in an 'optimised' staging/sequencing of works to manage risks in that region.

Given that different assets are owned by different service providers (e.g. Hunter Water Corporation, Department of Education) this will further complicate the coordination/sequencing of options to manage inundation risk. It will be important to work closely with these authorities to understand the risks to the different properties/assets and potential solutions to manage the risks. This will ensure alignment with the capital works programs of the different asset owners.

Funding options

There is considerable cost, lead time and further investigations to be undertaken in respect to several options under the CBA and implementation of any/all the LAP options. Consideration should be given to the approaches to funding the actions and whether the costs should be borne only by the beneficiaries of the actions or the wider community. The staging and sequencing of options could be undertaken to spread the costs of over several years. Council could also consider establishing a pooled fund to minimise 'spikes' in funds required in any particular year.

Implications for the LAP

As stated above, this CBA is one of a number of tools used to assess a limited number of options developed from the MCA, and it is highlighted that there are other options, drivers and considerations for discussion in the upcoming LAP. While the CBA results conclude that there are no specific actions that need to be incorporated into the LAP

immediately, there are a range of other actions evaluated as part of the MCA that will be incorporated into the upcoming LAP.

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